The role of Lean thinking in increasing resource efficiency in the UK food and drink supply chain

Sustainable products and services
Clean technologies
Resource efficiency

A report for
Defra
September 2013
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Executive summary

This study investigates the contribution Lean thinking can make to resource efficiency in the UK food and drink supply chain. Focus is placed in four specific stages in the chain:

- manufacturing
- distribution
- hospitality and foodservice
- retail.

The concept of Lean thinking was developed in the automotive sector in the 1950s through the pioneering work of Toyota in Japan. Lean thinking can be described as the pursuit of perfection by constantly eliminating ‘waste’ through problem solving. Lean is driven by economics and is based on operational efficiency. The definition of Lean thinking used throughout this research is:

‘Lean is a way of focusing on what the customer values and is willing to pay for; any activity that does not add to value, as perceived by the end customer, is waste. This waste includes any use of resources – cost, time, movement, material, energy, water, and labour’.

Traditionally, resource efficiency is driven through an environmental agenda and hence success is heavily dependent on a business’ commitment to the environment. From a waste perspective, resource efficiency can be traced back at least to the first European Waste Framework Directive in 1975 (75/442/EEC) where the concept of waste prevention and the waste hierarchy were introduced.

For this study, focus was placed on the three resources that fall into the scope for both Lean and resource efficiency, namely, energy, water and material (raw and waste material).

Table 2 shows the summary of the project objectives split into the three research phases. Unfortunately, the Phase 1 work found there to be little quantitative data available on the savings made through the implementation of Lean in the food supply chain. Key factors preventing the acquisition of robust evidence include:

- Most businesses that implement Lean do not measure the unanticipated environmental benefits.
- Financial savings made through such interventions are often regarded as commercially sensitive and hence are not communicated through the supply chain or more widely.
- Most businesses that implement Lean use in-house experts or contract services, and hence the outputs and findings from such initiatives remain in-house since they are regarded as a means of gaining competitive advantage.
- Businesses seldom measure the savings associated with individual interventions and, due to the sheer number of interventions undertaken at any one time, it is difficult to attribute savings to any one intervention.

The lack of robust evidence resulted in a major revision to the research objectives and the revised objectives, as developed by the project steering group, are shown in Table 2.

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Jeffrey Liker and Mike Rother. nd. Why Lean Programs Fail. Lean Enterprise Institute. Available at: http://www.lean.org/common/display/?o=1738
Table 1: A summary of the research phases and objectives

<table>
<thead>
<tr>
<th>Phase</th>
<th>Original Research Objectives</th>
<th>Revised Research Objectives</th>
</tr>
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<tbody>
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<td>2.5. Understand how the industry can take Lean forward to drive greater resource efficiency gains.</td>
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<tr>
<td>2: Further analysis &amp; case studies</td>
<td>2.1. Address key evidence gaps in current practices and uptake of tools and technologies;</td>
<td>2.1. Consider the extent to which food and drink businesses in retail, manufacturing, distribution and foodservice are already undertaking Lean.</td>
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<td>3.2. Provide guidance on the application of the modelling tool.</td>
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Interviews with stakeholders and evidence from case studies show that although quantitative data is not readily available there is an abundance of qualitative data showing that the food supply chain has fully embraced the Lean concept. At a time of economic uncertainty, companies are embracing Lean as a means of gaining competitive advantage and minimising the impact of such market conditions.

**How can we encourage more businesses to report their in-house savings?**

In terms of commercial sensitivity, waste, energy or water savings are not typically regarded as being of utmost sensitivity, especially when reported in non-financial terms. This statement is supported by the fact that many CSR reports now include benchmark data on resource use. Therefore, developing industry standard reporting protocols for CSR reports is considered a potential option.

Alternatively, trade associations are well placed to aggregate sector level data. The British Beer and Pub Association (BBPA) energy benchmarking work in breweries is considered a best practice example of this. It is acknowledged that this would be impractical in some sectors due to the extreme diversity of products.

**How can we best use government funding to improve the evidence base?**

The Waste Prevention Review and Pathfinder work at WRAP will add significantly to the current evidence base but more supporting evidence is required in developing the business case for Lean. One potential option is to fund a number of Lean demonstration projects where the findings from the project will be readily disseminated as part of the funding agreement.
Many of the medium and large businesses working in the food supply chain have signed up to voluntary agreements with the HaFS voluntary agreement and the Courtauld Commitment. Since these are sector level targets it is suggested that a higher degree of knowledge sharing should be encouraged.

What are the incentives and drivers?
Currently the retailers, such as M&S, are driving the uptake of Lean or Lean-like thinking in the food supply chain. Although this is commended and follows the general approach used in the automotive sector, one concern is that, unlike the automotive sector, each retailer is developing their own unique system. With more and more retailers developing their own systems greater burden will be placed on suppliers. This will be particularly relevant to SMEs that do not have the resources available to manage such individual compliance systems or to those supplying to multiple retailers. One option to overcome this is to develop an industry wide standard. This is discussed in detail in Section 1.

How to get started?
The research identified a gap in the availability of guidance on ‘How to’ implement Lean. It is therefore suggested that a set of guidance documents be developed. This may include guidance on:
- customer value – the research shows that many companies only perceive customer value from a product offering rather than process perspective
- Value Stream Mapping
- SMEs
- standardisation
- Visual Management Systems
- Demand Management Systems.

Limitations
The lack of robust data was a major setback for this research and resulted in the need to make significant changes to the original research objectives.
1 Report for Policy

1.1 Context

In 2007, Defra commissioned a study to quantify the no cost, low cost resource savings opportunities in all sectors of the UK economy. The study estimated that £6.4 billion could be saved per year with the food and drink supply chain being a major area of opportunity. Figure 1 shows the top five sectors identified in the study in terms of savings opportunity and the food and drink supply chain is a key part in the top three, namely:

- The UK road freight showed the greatest savings opportunity (£2,017 million). In 2010, the food, drink and tobacco sector accounted for 382 Mt of the 1,489 Mt of goods lifted by the UK freight sector\(^a\).
- Food and drink manufacture is second with savings of £995 million.
- The retail sector is third with a saving of £630 million\(^b\). In 2010, food, drink and tobacco accounted for £2,391 million of the average weekly retail sales with total retail sales, excluding fuel, of £5,622 million.


\(^b\) [http://www.ons.gov.uk/ons/dcp171778_323522.pdf](http://www.ons.gov.uk/ons/dcp171778_323522.pdf)


Energy, or more specifically fuel, savings accounts for the entire savings identified in the road freight sector. This is a key focus area for the Department for Transport (DfT) and the 2007 Defra report highlights the work of the Freight Best Practice Programme\(^c\).

Figure 1 shows that waste represents by far the greatest savings opportunity in the food and drink manufacturing and retail sectors, accounting for £858 million of the estimated savings in the food sector.

Figure 1: Quantification of resource efficiency benefits

**Quantification of the business benefits of resource efficiency, Defra 2007**
and drink manufacturing sector and £489 million in the retail sector. A key question arising from the 2007 study was how can these savings be realised?

This project, led by Oakdene Hollins with support from Brook Lyndhurst and the Resource Recovery Forum, explores the role that Lean thinking might play to improve resource efficiency in the UK food supply chain. Lean thinking can be described as the pursuit of perfection by constantly eliminating ‘waste’ through problem solving. The definition of Lean thinking used throughout this research is:

‘Lean is a way of focusing on what the customer values and is willing to pay for; any activity that does not add to value, as perceived by the end customer, is waste. This waste includes any use of resources – cost, time, movement, material, energy, water, and labour’.

Figure 2 shows how resource efficiency fits in to the broader Lean thinking concept and this study focuses specifically on the ‘wastes’ that fall under both the Lean and resource efficiency umbrellas, namely, energy, water and materials (raw and waste materials).

1.1.1 Project scope

This project examines resource efficiency from the farm gate to point of sale. The consumer stage of the supply chain is excluded from the present analysis, as are activities occurring within agriculture, fishing, aquaculture, packaging manufacture (Figure 3).

The four main sub-sectors within the scope of this project are:

- retailers
- manufacturers
- wholesalers and distributor
- hospitality and foodservice (HaFS).

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[Jeffrey Liker and Mike Rother. nd. Why Lean Programs Fail. Lean Enterprise Institute. Available at: http://www.lean.org/common/display/?o=1738]
1.2 Methods and approach

The project was split into three main research phases:

1.2.1 Phase 1: Literature review & expert engagement

Phase 1 was to map impacts, hot spots and tools in the food chain. Data gathering was through an exhaustive review of published and grey literature, and by engagement with relevant experts from government, academia, industry and NGOs. The extent of the search approaches also needed to have boundaries to make the process manageable.

- **Time:** We proposed bounding the extent of the time search to around 1995 which is when major programmes of waste minimisation were formalised using metrics broadly compatible with today’s.
- **Geography/language:** The primary target was the UK and US supply chains with a corresponding emphasis on materials published in English. This is because these two markets are significantly different from the rest of the world, with high levels of product and packaging innovation, multi-product lines and sizes and high turnaround rates not seen elsewhere. The manufacturing challenges are therefore significant and rapidly evolving. However, we also wished to seek examples of best practice in key European markets as benchmarks.
- **Sector scope:** The focus of the search was obviously on the food and drink supply chain, but available literature from other sectors would be included where there was clear relevance and learning available that applies to the food and drink supply chain e.g. the application of Lean systems to other manufacturing sectors such as automotive.

Any evidence gaps were to be identified.
1.2.2 Phase 2: Further analysis & case studies

Phase 2 was to conduct further analysis to fill the evidence gaps identified in Phase 1 and to investigate drivers and barriers to the further adoption of tools and technologies. A number of specific tasks and approaches were proposed, the implementation of which depended on the availability and quality of the evidence collated within Phase 1. With the agreement of the Steering Group and Defra a series of case studies was to be researched and conducted, to address key evidence gaps in current practices and uptake of tools and technologies. Importantly, any drivers and barriers to the further adoption of these tools and technologies would also be considered in the case studies.

1.2.3 Phase 3: Develop modelling tool

Phase 3 was to use the data collected to develop refined assessments of the opportunities for reducing impacts and improving performance, their costs and benefits, and options for promoting their uptake. A computer-based modelling tool was to be developed enabling users to assess the cumulative effects of different levels of uptake of multiple options and to assess the impact of each tool on each of the hotspots identified in the earlier phases; a Guidance Document would accompany the tool. This part of the original project had to be abandoned because of a lack of data arising from phase 1 of the research work.

1.2.4 Project objectives

Table 2 shows the summary of the project objectives split into the three research phases.

Table 2: A summary of the research phases and objectives

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2.3 Conduct case studies of environmental and economic performance in the food chain. |
| 3: Develop modelling tool | 3.1 Develop modelling tool to simulate the effect of options to improve current practice.  
3.2 Provide guidance on the application of the modelling tool. |

1.3 Results and conclusions

1.3.1 The lack of robust evidence

The Phase 1 work identified a lack of robust quantified evidence linking resource efficiency gains with Lean practices in the food supply chain. Without this robust evidence base, it is not possible to categorically favour Lean over other approaches in delivering the highest level of resource efficiency. Key factors preventing the acquisition of robust evidence include:

- Most businesses which implement Lean do not measure the unanticipated environmental benefits.
Financial savings made through such interventions are often regarded as commercially sensitive and hence are not communicated through the supply chain or more widely.

Most businesses which implement Lean use in-house experts or contract services and hence the outputs and findings from such initiatives remain in-house since they are regarded as a means of gaining competitive advantage.

Businesses seldom measure the savings associated with individual interventions and due to the sheer number of interventions undertaken at any one time it is difficult to attribute savings to any one intervention.

Currently, the best available evidence for Lean in the food supply chain comes from a small number of case study examples and through in-depth interviews with industry representatives. Further evidence will be generated via two work programmes currently being undertaken by WRAP, namely:

- WRAP will shortly be publishing the findings from their current phase of Waste Prevention Review (WPR) work with Courtauld Commitment signatories, where Lean thinking formed a core part of the delivery methodology. The focus of the WPRs is on the prevention of food and packaging waste.
- The Product Sustainability Forum (PSF) managed through WRAP will also be publishing the findings from their Pathfinder programme which also incorporates a Lean thinking approach. Further work is required to demonstrate how SMEs within the food supply chain can implement Lean and the level of savings that this will deliver.

In light of this lack of quantifiable evidence, substantial revisions to the original Phase 2 and 3 project objectives were required. For example, the development of the modelling tool (Phase 3) was no longer possible and hence a more qualitative approach was required. The revised objectives were:

- Consider the extent to which food and drink businesses in retail, manufacturing, distribution and foodservice are already undertaking Lean.
- Investigate the degree to which the industry achieves resource efficiency through the use of Lean practices.
- Undertake case studies and interviews with industry to assess if there is sufficient evidence to link Lean practices and efficiency gains.
- Identify the drivers and barriers to implementing Lean in the industry.
- Understand how the industry can take Lean forward to drive greater resource efficiency gains.

1.3.2 Consider the extent to which food and drink businesses in retail, manufacturing, distribution and foodservice are already undertaking Lean.

One of the key discussion points at the start of this study was the fundamental question on how to define Lean. Should the study focus on Lean in its purest form as transcribed in the Toyota learnings, or should it take a broader view, embracing a more general ‘continuous improvement’ approach? To overcome this difficulty, the Lean Improvement Pyramid (Figure 4) was developed to enable an assessment of the full spectrum of Lean intervention/application within the food sector, from common sense improvements to full Lean culture change. Evidence for this comes from ‘real world’ examples or case studies undertaken for this project.
Figure 4: The Lean Improvement Pyramid

This pyramid has three categories of Lean implementation, indicating the way in which companies approach Lean, and the associated commercial and environmental benefits:

- **Project-based Problem-solving**: At this level, companies of all sizes use a few Lean, or Lean-like, approaches or tools to solve specific, obvious inefficiencies in their processes which are incurring financial losses. Resource efficiency savings may also be achieved, but the tendency is for the actions to be short-lived and limited to that one process. Lean at this level is most often reactive, consisting of quick engineering fixes that use Lean-like techniques in the identification of the causative factors of a specific problem and the development of solutions. Prioritising projects through mapping exercises is absent at this level, and hence there is a high probability that the most significant savings opportunities are not being addressed. This is because projects are selected on the basis of the impact the problem has had over a short time frame (over the last week or last period). Additionally, focus is typically directed at special causes/one-off problems, i.e. major incidents, rather than the inherent causes/minor incidents. The study found most food companies currently operating at this level.

- **Systemised Problem-solving**: Small but increasing numbers of food companies are now reaching this level of Lean implementation. More time is spent planning projects, using such techniques as value stream mapping or Six Sigma DMAIC. This results in higher project success from identifying the significant savings opportunities. The more formal, systemised approach to Lean is reflected in the use of dedicated Lean teams and the development of Standard Operating Procedures (SOPs) to embed solutions. There is recognition of the need to disseminate Lean throughout the whole company, and to key partners in the supply chain.

- **Lean Culture**: This is the highest level of Lean seen in the food supply chain; only a handful of examples could be found of ‘fully Lean’ organisations which have undergone a top-to-bottom Lean transformation, with all functions continually examined and optimised for the value they add. Lean thinking becomes second nature for all employees, in all departments. Once identified anywhere in the supply chain, waste is eliminated using a variety of established or bespoke Lean tools. At this level, Lean and resource efficiency become more explicitly linked, with Lean or Continuous Improvement (CI) valued for the environmental added benefit they bring.

Lean has evolved from the automotive industry approach; the food and drink industry has made good progress in understanding its key principles and benefits. Food and drink retailers are applying
Lean to their supply chains in much the same way as the car manufacturers implemented Lean in their supply chain in the 1970s and 1980s. Marks and Spencer is a case in point having developed a gold, silver and bronze performance standard to benchmark the relative environmental and economic performance of their suppliers. This system provides an incentive for suppliers since those that have ‘earned recognition’ are likely to gain greater market share. Multinationals such as Kellogg’s and McDonalds also see competitive advantage in a leaner, and continually improving, supply chain.

SME engagement with Lean differs according to the size of business. Food and drink companies with over 100 employees are likely to use formal Lean or CI approaches since they have formalised organisational structures in line with those of the larger organisations. Smaller SMEs and, in particular, the ‘micro’ category employ a ‘common sense’ approach to reducing costs based on the ‘if it saves money it is worth doing’ adage.

1.3.3 **Investigate the degree to which the industry achieves resource efficiency through the use of Lean practices.**

Lean has great potential in unlocking the £1 billion of identified resource efficiency opportunities in the food and drink supply chain. Lean thinking has been used for decades but has only recently been linked to ‘green’, thus quantitative data is difficult to find. Lean’s aim of waste prevention points to synergy between the two.

Lack of data prevented the ability to align financial, or resource efficiency, values with each level of the Pyramid (Figure 4). What did become apparent in the course of the research was the degree of opportunity achievable at each level. Figure 5 summarises these opportunities, in terms of lowest to highest benefits – be these commercial or environmental.

*Figure 5: Mapping the opportunity at different levels of Lean engagement*

The graph corresponds to the three levels of the Lean Improvement Pyramid, showing the trade-off between time spent on Lean implementation and the benefits gained. Benefits can relate to the level of cost reduction, waste minimisation and competitive advantage gained.
It is not possible, due to the lack of available data, to quantify the resource efficiency savings associated with Lean projects at this level. However, given the profile of companies often operating at this level, certain assumptions can be made about the type, or scale, of efficiencies that Lean brings (Figure 6).

*Figure 6: Examples of resource efficiency savings at each level on the Lean improvement Pyramid*

An estimate of the potential savings and summary of the findings is shown in Table 3:

*Table 3: Resource efficiency (RE) benefits from a Lean approach*

<table>
<thead>
<tr>
<th>Lean stage</th>
<th>Methodology</th>
<th>RE benefits of using Lean – best available evidence</th>
<th>Commonly used Lean tools¹</th>
<th>Potential associated resource efficiency gains</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lean Culture</strong></td>
<td>Fully Lean organisation; all processes optimised for waste minimisation. VSM used at its most powerful, to improve supply chain efficiencies.</td>
<td>14.5% reduction in red meat raw materials waste²</td>
<td>VSM/mapping of entire supply chain; 6s DMAIC; Supplier scorecards; Lean driven by all employees; All tools used at other two levels.</td>
<td>Large scale savings across all products or distribution channels: Specific, measured carbon/water/energy reductions; Large scale carbon savings via optimising delivery networks; Driving waste reduction via supplier scorecards.</td>
</tr>
<tr>
<td>Systemised problem-solving</td>
<td>More formal Lean programme; time spent planning projects and embedding results with SOPs. VSM</td>
<td>8.6% reduction in red meat raw material waste²</td>
<td>Kaizen (pre-planned event); VSM (mapping a process); 6s DMAIC; SOPs and KPIs to Starting to get significant RE savings through roll-out Lean programmes: Knowledge integration via IT = reduction in paper etc; Waste and</td>
<td></td>
</tr>
</tbody>
</table>

¹ Each level includes the tools used at the level below as a given
² See 5.4.3: results from quantified red meat study
The US Environmental Protection Agency (EPA) exemplifies the first steps taken by an international regulatory body to link Lean and resource efficiency. The work undertaken by the EPA provides an example of how governments can provide support in the area by addressing perceived barriers to uptake and facilitating knowledge transfer. The US EPA has used Lean in its traditional sense, linking it with environmental impacts (Table 4):

Table 4: Environmental impact of Lean’s ‘Seven Deadly Wastes’

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

1.3.4 Undertake case studies and interviews with industry to assess if there is sufficient evidence to link Lean practices and efficiency gains.

The lack of a robust evidence base means that it is not possible to categorically favour Lean over other approaches in delivering the highest level of resource efficiency. Conversely, there is sufficient evidence to link Lean practices with efficiency gains (Table 3).

1.3.5 Identify the drivers and barriers to implementing Lean in the industry.

The competitive nature of Lean and its accompanying terminology may be more appropriate to business than that of resource efficiency. Lean is driven by competitive advantage and therefore gains more organisational support than resource efficiency. Lean/CI also speaks the language of the industry more effectively than resource efficiency, especially for SMEs. Promoting the link between the two breaks down barriers between production/operational management and environmental management/CSR.

Food and drink businesses of all sizes are already seeking ways to improve their resource efficiency. There is much innovation in the industry, both in products and processes. Food and drink businesses are responding positively to environmental concerns and acknowledge their role in contributing to future sustainable growth. The industry is well placed to unlock greater resource efficiency opportunities through Lean, or Lean-like practices.

Lean appears most successful with the catalyst of supply chain collaboration. Much like the automotive industry, supply chain pressure can drive waste reduction in the industry. Industry interviews undertaken for this report found that collaboration acts as a vehicle for exchanging ideas and improvements. Other external catalysts such as government-funded training and programmes, and delivery bodies such as the Manufacturing Advisory Service (MAS), also assist companies to take the first steps in adopting Lean.

SMEs have generally positive attitudes towards the idea of Lean and related concepts, but lack a thorough understanding of these concepts and are prone to misinterpreting definitions. Lean is often seen as ‘common sense’ and there is a general feeling amongst SMEs that they are already taking sufficient action in this area – even though the evidence shows that they lack many of the basic Lean competencies. Many micro SMEs and MSBs still need to be convinced of the benefits of Lean or CI.

SMEs often misunderstand the terms ‘customer value’ and ‘resource use’. Customer value is perceived to be adding value to the end product only. This means that as long as customers are buying the product at its current price, the SME can consider itself to be delivering value to its customers. The SME therefore focuses its attention on the cost of inputs and the value of sales. The production process becomes a ‘black box’ in between, with no consideration given to whether it truly creates value for customers or not. Additionally, resource use is linked to staff, money etc and not waste, water and energy. Wastage is a better term and is more readily linked to unnecessary raw material loss by SMEs.

In summary, the major barriers to implementing Lean within the food supply chain are:
- lack of resources – time, money, training, perceived and actual complexity of Lean
- perceived requirement to change ‘the culture’
- lack of motivation and commitment
- low skill level and unfamiliarity with English language
- rapid turnover of product ranges
- seasonal availability of products
- natural product variation
- high level regulation and food safety
- people-orientated, rather than automated
- large number of SMEs in the supply chain.

The barriers show where progress still needs to be made in preparing the industry to take Lean forward, as well as deciding how to ‘sell’ Lean to the food industry through policy intervention or promotional material.

1.3.6 Understand how the industry can take Lean forward to drive greater resource efficiency gains.

The benefits of Lean are greatest when the correct approach to problem-identification is employed. Value Stream Mapping and other forms of planning should be done before using more specific Lean tools to solve problems. Planning targets the most significant opportunities and guards against short-term solutions which fail to become embedded.

The concept of ‘customer value’ may offer a promising starting point for engaging SMEs in thinking about Lean. This is a concept that strongly resonates with SMEs, and could offer a fresh angle for discussion, following the recent focus on ‘cost-cutting’ or ‘cost savings’ that has been prevalent in many recent resource efficiency communications. Gradually building on the concept of ‘customer value’ and enhancing SMEs’ understanding of it could encourage them to begin Leaning their operations.

1.3.7 The benefits of adopting Lean practices for resource efficiency improvements

Starting ‘Lean’ and ending ‘Green’. Companies typically embark on the Lean journey to improve competitive advantage rather than for environmental reasons. At the top level of engagement, however, resource efficiency has become more explicitly linked with Lean. Moreover, the rising prominence of quantitative CSR reporting and the greater integration of its role within the company is encouraging businesses, especially larger ones, to link Lean with its environmental benefits.

Conversely it should be acknowledged that Lean approaches may contradict environmental best practice. Evidence is scarce, but in theory it is possible for Lean principles to increase resource use rather than reduce it: for example, where more resources are used, such as energy, water and chemicals, to speed up a production line wash down/product changeover.

1.4 Interpretation of results

The research shows that there is a fundamental gap in the current evidence base. This prevents the true value of a Lean approach from being quantified and inevitably this inhibits the business case for adopting Lean. In addition, businesses that do overcome this barrier are then confronted with a lack of readily available guidance on how to implement Lean and how to get started. This raises two key discussion points:

- How to address the lack of robust data?
- How to increase the uptake of Lean?

1.4.1 How to address the lack of robust data

As with any initiative, companies want to know what the possible financial return of a Lean project will be. Crucially, however, there is a lack of quantitative data publically available for companies to be able to benchmark themselves against others in the industry, resulting in companies viewing such
initiatives with scepticism. Those companies that have adopted Lean often regard it as ‘first mover advantage’ and hence are wary of losing competitive advantage by sharing quantitative data.

This statement can be broken down into two parts:
- How can we encourage more businesses to report their in-house savings?
- How can we best use government funding to improve the evidence base?

**How can we encourage more businesses to report their in-house savings?**

In terms of commercial sensitivity, waste, energy or water savings are not typically regarded as of utmost sensitivity, especially when reported in non-financial terms. This statement is supported by the fact that many CSR reports now include benchmark data on resource use. Therefore, developing industry standard reporting protocols for CSR reports is considered a potential option.

Alternatively, trade associations are well placed to aggregate sector level data. The British Beer and Pub Association (BBPA) energy benchmarking work in breweries is considered a best practice example of this. It is acknowledged that this would be impractical in some sectors due to the extreme diversity of products.

**Is there a need for government funding to improve the evidence base?**

The Waste Prevention Review and Pathfinder work at WRAP will add significantly to the current evidence base but more supporting evidence is required in developing the business case for Lean. One potential option is to fund a number of Lean demonstration projects where the findings from the project will be readily disseminated as part of the funding agreement.

Many of the medium and large businesses working in the food supply chain have signed up to Voluntary agreements with the HaFS voluntary agreement and the Courtauld Commitment. In these cases, we suggest that a higher degree of knowledge sharing should be encouraged.

### 1.4.2 How to increase the uptake of Lean

**Incentives and drivers**

Currently the retailers, such as M&S, are driving the uptake of Lean or Lean-like thinking in the food supply chain. Although this is commended and follows the general approach used in the automotive sector, one concern is that, unlike the automotive sector, each retailer is developing their own unique system. With more and more retailers developing their own systems greater burden will be placed on suppliers. This will be particularly relevant to SMEs that do not have the resources available to manage such compliance systems or to those supplying to multiple retailers. One option to overcome this is to develop an industry wide standard.

This industry standard could draw on the learning from M&S in the use of the gold, silver, and bronze classifications and could also use the Lean Improvement Pyramid. To a certain extent, the identification process and Lean tools used by a company gives an indication as to its level on the Pyramid. Most tools can be used at each level of the Pyramid; however, the research found that some were more often found at a certain level, or that the way they were *used* was different at each level (Figure 7). This could therefore be used to form the checklist and classification process.
How to get started
The research identified a gap in the availability of guidance on ‘How to’ implement Lean. It is therefore suggested that a set of guidance documents be developed. This may include guidance on:

- customer value – the research shows that many companies only perceive customer value from a product offering rather than process perspective
- value stream mapping (VSM)
- SMEs
- standardisation
- visual management systems (VMSs)
- demand management systems (DMSs).

1.5 Limitations
The lack of robust data was a major setback for this research and resulted in the need to make significant changes to the original research objectives.
Acknowledgements


This report is dedicated to the memory of Kit Strange of the Resource Recovery Forum, a member of our original project team, who sadly passed away in August 2011.
## Abbreviations

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<tr>
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<th>Description</th>
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<tr>
<td>ADKAR</td>
<td>awareness, desire, knowledge, ability, reinforcement</td>
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<tr>
<td>CI</td>
<td>continuous improvement</td>
</tr>
<tr>
<td>CIP</td>
<td>clean in place</td>
</tr>
<tr>
<td>CSR</td>
<td>corporate social responsibility</td>
</tr>
<tr>
<td>Defra</td>
<td>Department for Environment, Food and Rural Affairs</td>
</tr>
<tr>
<td>DMAIC</td>
<td>define, measure, analyse, improve, control</td>
</tr>
<tr>
<td>EDLC</td>
<td>every day low cost</td>
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<tr>
<td>EDLP</td>
<td>every day low price</td>
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<tr>
<td>EMS</td>
<td>environmental management system</td>
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<tr>
<td>EPI</td>
<td>environmental performance indicator</td>
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<tr>
<td>FMCG</td>
<td>fast moving consumer good</td>
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<tr>
<td>FISS</td>
<td>Food Industry Sustainability Strategy</td>
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<tr>
<td>GVA</td>
<td>gross value added</td>
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<td>HACCP</td>
<td>hazard analysis and critical control points</td>
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<tr>
<td>HSE</td>
<td>health, safety and environment</td>
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<tr>
<td>INCPEN</td>
<td>Industry Council for Packaging and the Environment</td>
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<tr>
<td>JIT</td>
<td>just in time</td>
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<tr>
<td>KPI</td>
<td>key performance indicator</td>
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<tr>
<td>MAS</td>
<td>manufacturing advisory service</td>
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<td>MSB</td>
<td>medium small business</td>
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<td>OOD</td>
<td>out of date</td>
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<tr>
<td>OSA</td>
<td>on-shelf availability</td>
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<td>RDC</td>
<td>regional distribution centre</td>
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<td>RE</td>
<td>resource efficiency</td>
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<td>RTP</td>
<td>returnable transit packaging</td>
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<tr>
<td>SKU</td>
<td>stock keeping unit</td>
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<td>SME</td>
<td>small and medium enterprise</td>
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<tr>
<td>SMED</td>
<td>single-minute exchange of die</td>
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<tr>
<td>SOP</td>
<td>standard operating procedure</td>
</tr>
<tr>
<td>tCO2e</td>
<td>equivalent in tonnes of carbon dioxide emitted</td>
</tr>
<tr>
<td>toe</td>
<td>equivalent in tonnes of oil used</td>
</tr>
<tr>
<td>TPS</td>
<td>Toyota Production System</td>
</tr>
<tr>
<td>US EPA</td>
<td>United States Environmental Protection Agency</td>
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<tr>
<td>VSM</td>
<td>value stream mapping</td>
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<tr>
<td>WRAP</td>
<td>Waste &amp; Resources Action Programme</td>
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Glossary

**Awareness, Desire, Knowledge, Ability, Reinforcement (ADKAR)**
ADKAR is a change management model. Each of the letters represents a goal or outcome of a change within an organisation.

**Ambient products**
Ambient products require storage at a specific temperature. Ambient refers to the temperature of the surroundings, or in some cases 'room temperature.'

**Call-off system**
A call-off system can be put in place to ensure control of stock. A call-off stock system streamlines the process of sending orders to dispatch stock which is held by a third party. This ensures that stock levels are sufficiently replenished and that stock is always available.

**Change management**
Change management refers to a structured period of transition in an organisation, moving from a current state to a desired further state. Change management uses basic structures and tools to control organizational change. The goal is to maximize benefits and minimize the impacts on workers.

**Clean in place (CIP)**
CIP is a method of cleaning the interior surfaces of process equipment, filters and associated fittings, without disassembly.

**Continuous improvement (CI)**
The process of making regular small changes and improvements to the products, services, etc. of a company rather than a few big changes.

**Courtauld Commitment**
a voluntary agreement, or responsibility deal, aimed at improving resource efficiency and reducing the carbon and wider environmental impact of the grocery retail sector.

**Define, Measure, Analyse, Improve, Control (DMAIC)**
DMAIC refers to a data-driven improvement cycle used for improving, optimizing and stabilizing business processes and designs. The DMAIC improvement cycle is the core tool used to drive Six Sigma projects. DMAIC is not exclusive to Six Sigma and can be used as the framework for other improvement applications.

**De-listing**
If a product is de-listed it is removed from the list of those sold by a retailer. This will most often be due to poor sales or profit realisation.

**Demand amplification**
The difficulties associated with schedule of supply and production to meet demand. Demand can be erratic with peaks and troughs commonplace within most organizations. These variations in requirements and supply are amplified within the supply chain when re-orders are made; this is then rippled through the tiers of the supply chain (distributors, manufacturers, raw material suppliers). Accommodating these fluctuations increases waste/costs by building inventory and lengthening lead times.
Department for Environment, Food and Rural Affairs (Defra)
The UK Government Department responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities in the United Kingdom.

Environmental Performance Indicator (EPI)
Any metric or measure used by companies to report on their environmental performance.

Environmental Management System (EMS)
An EMS manages an organisation’s environmental programs in a comprehensive, systematic, planned and documented manner. It includes the organisational structure, planning and resources for developing, implementing and maintaining policy for environmental protection.

Every day low price (ELDP)
ELDP is an approach to product pricing used by some retailers, notable Wal-Mart in the USA and its UK subsidiary ASDA. EDLP gives credible consistent pricing by offering products at a consistently low price.

US Environmental Protection Agency (EPA)
The Environmental Protection Agency is an agency of the US federal government which was created for the purpose of protecting human health and the environment.

Food service
The food service sector includes any company responsible for meals prepared outside the home. This industry includes restaurants, school and hospital cafeterias, catering operations, and many other formats.

Forecasting
A planning tool to help businesses cope with uncertainty of the future, forecasting typically relies on data from the past and present, and analysis of trends.

Fast-moving consumer goods (FMCG)
Fast-moving consumer goods are products that are sold quickly and at relatively low cost. Examples include non-durable goods such as soft drinks, toiletries, and grocery items.

Greenhouse gas (GHG) emissions
A greenhouse gas is any of the atmospheric gases that contribute to the greenhouse effect by absorbing infrared radiation produced by solar warming of the Earth’s surface. This includes: carbon dioxide, methane, ozone, and the fluorocarbons.

Gross value added (GVA)
Gross value added is the value of output less the value of intermediate consumption.

Hazard analysis and critical control points (HACCP)
HACCP is the systematic preventative approach to food safety. It addresses physical, chemical, and biological hazards as a means of prevention rather than finished product inspection.

High-low pricing
A product pricing strategy used by retailers, based on significantly reducing a product’s price (i.e. a promotion) for a short time before reverting to full price. This pricing method relies on attracting customers to stores in search of unbeatable short-term bargains.
**Industry Council for Packaging and the Environment (INCPEN)**
A non-profit, research-based organisation established in 1974 dedicated to analysing the environmental and social effects of packaging.

**Just in Time (JIT)**
An inventory strategy companies employ to increase efficiency and decrease waste by receiving goods only as they are needed in the production process, thereby reducing inventory costs.

**Kaizen**
A Japanese business philosophy, the word ‘kaizen’ is Japanese for "improvement" or "change for the better". The Kaizen philosophy focusses on the continuous improvement of processes in manufacturing, engineering, and general business management.

**Kanban**
Kanban is a Japanese term meaning “signboard or graphic”. It is a type of inventory control system based on a series of coloured cards. These cards denote such factors as quantity, the type of part and the manufacturer. A card is placed in the bin or other container with each group of manufactured items as an identifier for those involved with the next phase of production or distribution.

**Key Performance Indicator (KPI)**
A very important indicator (something that shows what a situation is like or how it is changing) that shows how well an economy, company, stock, project, etc., is doing.

**Lead time**
The delay between the initiation and completion of a process. Customer lead time is the time from the moment the customer places an order to the moment it is received by the customer. Order processing lead times include the time taken to purchase, produce and distribute an order.

**Lean**
Lean manufacturing is a manufacturing philosophy that considers using resources for any other goal than the creation of end customer value to be wasteful, and thus a target for elimination.

**Lightweighting**
Making a product lighter or ensuring that it is at its optimum weight, whilst ensuring that its existing product characteristics, and hence product performance, remain uncompromised.

**Manufacturing Advisory Service (MAS)**
Funded by BIS (Department for Business, Innovation and Skills), MAS provides manufacturing business support for SME companies based in England, helping them to streamline processes, reduce waste, become more energy efficient and generally improve and grow their business.

**Medium small business (MSB)**
A term for businesses with 10-100 employees.

**Micro business**
Small business employing fewer than 10 people.

**Open-book accounting**
Open-book accounting requires an organisation's accounts to include all those with an interest in the organisation, not merely its employees and its shareholders. Although this sometimes means all
members of the public, it usually relates just to the sharing financial information between client (retailer) and supplier.

**Plan-do-check-act (PDCA)**
The plan-do-check-act cycle is an iterative management process used in business for the control and continuous improvement of processes and products. The cycle is continuous; repeating the PDCA cycle should bring an organisation closer to a perfect operation or output.

**Primary packaging**
The material that first envelops the product and holds it. This usually is the smallest unit of distribution or use and is the package which is in direct contact with the contents.

**Regional Distribution Centre (RDC)**
One of a network of large warehouses operated for a single retailer. An RDC is where merchandise is consolidated prior to delivery to its local stores.

**Resource efficiency (RE)**
RE can be defined as using the planet’s limited resources in a sustainable manner whilst at the same time minimising the impact of human activity on the environment. Being resource efficient allows companies to create more using less and to deliver greater value with fewer inputs.

**Secondary packaging**
Secondary packaging is outside the primary packaging, perhaps used to group primary packages together.

**Silo working**
Silo working refers to an isolated way of operating, in which various business departments and employees work independently from each other with little collaboration.

**Single-minute exchange of die (SMED)**
SMED is a Lean production method. It refers to a rapid and efficient way of converting a manufacturing process from running the current product to running the next product. This rapid changeover is key to reducing production lot sizes and thereby improving flow. The phrase "single minute" does not mean that all changeovers and start-ups should take only one minute, but that they should take as little time as possible.

**Six Sigma**
Six Sigma is a measure of quality that strives for near perfection in a given process. Six Sigma is a data-driven approach to eliminating error in any given process – from manufacturing to financial transactions. The Six Sigma approach can be applied to both products and services.

**Small and medium enterprise (SME)**
In the UK, a small company or enterprise is defined by the Companies Act (2006) as one that has an annual turnover of not more than £6.5 million, a balance sheet total of not more than £3.26 million and not more than 50 employees. A medium-sized company or enterprise has a turnover of not more than £25.9 million, a balance sheet total of not more than £12.9 million and not more than 250 employees.
**Standard operating procedure (SOP)**
A document which describes the regularly recurring operations relevant to a particular process or procedure. The purpose of having an SOP document is to ensure that operations are always carried out correctly and in a uniform and consistent manner.

**Stock keeping unit (SKU)**
An item in a company’s inventory.

**Stock turns**
Stock (or inventory) turns is the number of times per year that the stock of a given product is turned over in relation to the sales revenue of a given product. It is calculated from dividing the sales turnover of products by the average inventory value of the product.

**Takt-time**
The maximum time per unit allowed producing a product in order to meet demand.

**Tertiary packaging**
Packaging used for bulk handling, warehouse storage and transport shipping.

**Toyota Production System (TPS)**
The Toyota Production System is a process for manufacturing, developed by Toyota in Japan. Its development was based on the principles of quality control and just-in-time production.

**United States Environmental Protection Agency (US EPA)**
The United States Environmental Protection Agency’s primary mission is to protect human health and the environment in the USA. It achieves this through enforcing federal environmental law, inputting to federal environmental legislation, supporting international co-operation on environmental issues and by conducting and financing scientific research on environmental issues.

**Value stream mapping (VSM)**
A Lean manufacturing technique used to understand, monitor and control the flow of materials and information that are needed in order to get a given product or service to a consumer. VSM can be applied to almost any manufacturing value chain. Some academics and consultants propose a sustainable value stream map (SVSM) or environmental value stream map (EVSM) as a way of aligning economic or environmental impacts.

**Vertical integration**
The merging together of businesses that are at different stages of production (for example, a food manufacturer and a chain of supermarkets). Vertical integration can be contrasted to horizontal integration, the merging together of businesses that are at the same stage of production (such as two supermarkets, or two food manufacturers).

**Waste & Resources Action Programme (WRAP)**
WRAP is a not-for-profit, government-backed British company that helps businesses, local authorities, communities and individuals across the United Kingdom reduce their waste, develop sustainable products and use resources more efficiently.

**Waste**
Under the EU Waste Framework Directive (2008), waste is defined as "an object the holder discards, intends to discard or is required to discard".
Yield Loss
Yield refers to the amount of a product. Yield loss describes the wastage of this product at any given stage of the supply chain.

5S
5S is a Lean tool. The 5S pillars, Sort (Seiri), Set in Order (Seiton), Shine (Seiso), Standardise (Seiketsu), and Sustain (Shitsuke), provide a methodology for organizing, cleaning, developing, and sustaining a productive work environment.
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2 Challenges in the food and drink supply chain

2.1 Introduction

2.1.1 Project aims

Lean thinking is driven by customer value, with anything not valued by the end customer being classified as waste. By examining every part of an organisation and its supply chain, Lean can identify and minimise waste - be this wasted time, cost, movement, raw material, energy, water or labour. Lean may thus lend itself to the objective of resource efficiency.

This project, led by Oakdene Hollins with support from Brook Lyndhurst and the Resource Recovery Forum, explores the role that Lean thinking might play to improve resource efficiency in food supply chains.

The objectives for the research were to:

- Consider the extent to which food and drink businesses in retail, manufacturing, distribution and foodservice are already undertaking Lean.
- Investigate the degree to which the industry achieves resource efficiency through the use of Lean practices.
- Undertake case studies and interviews with industry to assess if there is sufficient evidence to link Lean practices and efficiency gains.
- Identify the drivers and barriers to implementing Lean in the industry.
- Understand how the industry can take Lean forward to drive greater resource efficiency gains.

There is a sense that resource efficiency is difficult to communicate to businesses, particularly SMEs. Taking a process-orientated approach, which is more widely understood by industry, may prove a more successful way of conveying such environmental aims.

The approach taken in this report was to investigate the quality of any existing research on using Lean in the food industry to drive resource efficiency, and then to fill the gaps by undertaking wide ranging industry interviews with all types of companies in the food supply chain. In addition, targeted qualitative research was conducted to assess the position of SMEs in relation to Lean activities.

2.1.2 Report structure

The report is structured as follows:

- Sections 2 and 3 provide an overview of the challenges facing the food industry in general, and the value, type and cause of resource inefficiency in the food and drink supply chain. It gives an indication of the scale of the opportunities available in reducing waste through Lean or any other means.
- Section 4 introduces the concept of Lean – its origins, definition, benefits and commonly used tools. It also looks at any existing links between Lean and green in other industries, and highlights the few occasions when Lean practices contradict environmental aims. It concludes by looking at the drivers for Lean in the food and drink supply chain.
- Section 5 assesses the current level of Lean activity in the supply chain, using examples from literature and from industry interviews conducted in the course of this research. It introduces the concept of the Lean Pyramid as a means of categorising levels of engagement with Lean,
and the types of approaches used at each level. Case studies offer real world examples as a means of benchmarking within the industry.

- Section 6 looks at the barriers of using Lean in this sector. It provides a view of areas where the industry needs particular help to move forward with Lean.
- Section 7 assesses the options for implementing and promoting Lean as a method of reducing waste and increasing resource efficiency.
- The interim reports produced to inform the study can be seen in:
  - Appendix 3: Hotspots report
  - Appendix 4: Hospitality and Foodservice (HaFS) report
  - Appendix 5: Manufacturing and Filling report
  - Appendix 6: Retail and Distribution report.

### 2.1.3 Project scope

This project examines resource efficiency from the farm gate to point of sale. The consumer stage of the supply chain is excluded from the present analysis, as are activities occurring within agriculture, fishing, aquaculture, packaging manufacture (Figure 8).

*Figure 8: Project scope*

The four main sub-sectors within the scope of this project are:

- retailers
- manufacturers
- wholesalers and distributor
- foodservice/hospitality.

For the purpose of this report, these four sub-sectors are described as the food and drink supply chain.
2.2 Industry overview

Figure 9 shows that the food and drink industry is a large and important sector of the UK business economy. The supply chain consists of over 188,000 companies and employs over 3.2 million people. In 2010, the agri-food sector contributed £89.1 billion or 7% to the UK’s GVA, up from 6.9% in the previous year. Figure 9 shows that retail, manufacture, foodservice and wholesalers contributed a combined GVA of £81.6 billion in 2012.

Figure 9: Overview of the UK food and drink supply chain (2012)

Source: Defra Food Pocketbook (2012) adapted by Oakdene Hollins

2.3 Pressures on the food industry

The food and drink industry is subject to many economic and commercial pressures, some of which are shared with all UK businesses and some of which are specific to the sector. As a result of these pressures, profit margins in the industry can be tight, placing a greater emphasis on operational cost control. At the same time, evidence suggests that the efficiency with which natural resources such as energy, water and - in particular - raw materials, are used across the food and drink supply chain could be far greater. By improving its resource efficiency, the sector could gain financially whilst reducing pressure on the environment.

The Lean manufacturing concept, originating in the Japanese automotive industry, aims to eliminate all forms of waste and offers an approach to achieving these twin goals. This report explores the extent to which Lean is currently used in the UK food and drinks sector and the contribution it might make towards future natural resource efficiency.

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a GVA = gross value added (difference between the value of goods/services produced and the cost of materials and other inputs)
b Defra (2012) Food Pocketbook
c WRAP (2012) Waste arising in the food and drink supply chain not yet published
Pressures on the food industry are growing and have the effect of making the industry both more in need of efficient resource use whilst at the same time limiting the available time and money to drive these improvements. Figure 10 summarises some of the key pressures.

Figure 10: Pressures in the UK food supply chain

http://www.grant-thornton.co.uk/Documents/Food_Report_2010.pdf
Key evidence supporting Figure 10 is:

- **Economic pressures** – the sector is resilient, given its daily necessity to consumers, with 2010 seeing an annual GVA increase of 4.2%. It is nevertheless susceptible to falling customer expenditure.

- **Consumers trading down to cheaper food ranges** – A *Which?* report from 2011 stated that 41% of shoppers have traded down to a cheaper brand and 41% now buy supermarket own-brand ranges rather than branded products.

- **Consumers still eating out, but in cheaper establishments** – This trend may be reflected in the 0.9% fall in foodservice industry expenditure in 2011.

- **Increases in raw material costs** – Over the last two decades, prices for oil, maize, barley, wheat and other commodities upon which the food industry depends, have risen sharply (Figure 11).

**Figure 11: Changing commodity prices, August 1994 to September 2012**

![Figure 11: Changing commodity prices, August 1994 to September 2012](source: US Bureau of Labor Statistics)

2.4 **Resource efficiency and the role of Lean thinking**

Much research has already been undertaken to identify the opportunities for resource efficiency in the food and drink industry, driving the Courtauld Commitment industry targets. In short, around 6.5 million tonnes of waste arise in the manufacture, distribution and retailing of food and drink. Most (75%) of this waste is produced in food manufacturing. The economic cost of this ‘supply chain’ waste is estimated at around £5 billion.

In terms of environmental performance, the supply chain uses about 18 Mtoe of primary energy and 43.2 MtCO₂e of greenhouse gas emissions. Up to date water data are difficult to find but a 2004 report from C-Tech estimated the food and drink supply chain to use 479 Mm³.

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*a* Defra (2011), *Food Pocketbook*

*b* *Which?* (2011) *The Impact of Rising Food Prices*

*c* Defra (2011), *Food Pocketbook*


*e* Waste refers to raw materials, as well as packaging, energy and water.

*f* WRAP (2012) *Waste arising in the food and drink supply chain not yet published*

*g* WRAP (2011) *Opportunities for resource efficiency in the food and drink sector*


*i* C-Tech Innovation Ltd (2004) *UK Food and Drink processing: advisorys Balance*
Significant opportunities exist to improve waste, energy and water efficiency, and to cut carbon emissions. Defra states on its website, under the Food Industry Sustainability Strategy (FISS) 2006 section, that the food and drinks industry accounts for:

- about 14% of energy consumption by UK businesses and 7 million tonnes of carbon emissions (MtCO₂e) per year;
- about 10% of all industrial use of the public water supply;
- about 10% of the industrial and commercial waste stream; and
- 25% of all HGV vehicle kilometres in the UK.

A report on the benefits of resource efficiency, published by Defra in 2007, estimates that nearly £1 billion in no-cost/low-cost resource efficiency savings was available across the UK food and drink industry. The savings opportunities from water and energy efficiency, £77 million and £60 million respectively, are dwarfed by material waste prevention opportunity of £858 million\(^b\) (Figure 12).

Figure 12: Potential resource efficiency savings in the food and drink industry

[Diagram showing resource efficiency savings distribution]

Source: Defra (2007)

WRAP (the Waste & Resources Action Programme) has long focused on identifying and eliminating waste in the food and drinks sector. Its latest review suggests almost 6.6 million tonnes of such waste arisings across the retail supply chain\(^c\) (Table 5).

<table>
<thead>
<tr>
<th>Waste stream</th>
<th>UK (Mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail</td>
<td>1.49</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>4.92</td>
</tr>
<tr>
<td>Wholesale &amp; Distribution</td>
<td>0.15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6.56</strong></td>
</tr>
</tbody>
</table>

Source: WRAP (not yet published) Retail Supply Chain Waste Baseline Review. Excludes product to animal feed, redistribution via charity or rendering

In the food service and hospitality sub-sector, waste is estimated to be 5.7 million tonnes\(^c\).

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\(^b\) Defra (2007) Quantification of the business benefits of resource efficiency. Oakdene Hollins & Grant Thornton
\(^c\) WRAP (2012) Waste arising in the food and drink supply chain not yet published
Waste takes many forms and includes the following ‘hidden’ costs in addition to the actual loss of product:

- disposal costs
- management time
- processing costs
- transportation
- rework
- storage
- water
- energy
- labour.

Figure 13 shows the key points at which these types of waste occur in the supply chain:

*Figure 13: Waste in the food supply chain*

Taking all this embedded waste into account, WRAP estimates the true costs of waste as £500 per tonne for manufacturing, £1,088 per tonne for wholesale and distribution, and £1,676 per tonne for retail\(^b\). On this assumption, eliminating waste from the retail supply chain alone could be worth around £5 billion every year.

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\(^b\) WRAP (2012) Supply chain: manage and measure waste
Innovation in product design, lightweighting of packaging, improvements in shelf life technology and collaboration with suppliers are just some of the ways in which the industry is already tackling waste.

With many of the ‘easy wins’ in efficiency improvements already undertaken, the question is how to unlock further resource efficiency savings. Businesses that can improve the efficiency with which they use energy and raw materials will obviously be at a competitive advantage, as well as contributing to lowering environment impacts.

The challenge for food and drink companies, as well as policy makers and delivery bodies, is how to drive these improvements throughout the industry. Many consider that Lean thinking may be the best solution. Originating in the Japanese automotive industry more than fifty years ago, the set of management tools and techniques labelled as ‘Lean’ has been adopted widely in manufacturing and the service sector around the world. While environmental imperatives are not the primary focus of Lean, its emphasis on minimising ‘waste’ in all forms would seem ideally suited to achieving resource efficiency.

A report published by WRAP in 2010\(^a\) appeared to support this theory, showing that Lean techniques produced greater energy-saving quick wins and longer-term best practice than competing approaches (Figure 14).

*Figure 14: Degree of CO\(_2\) energy saving using a variety of methods*

![CO2 energy saving chart](chart.png)

Source: WRAP (2010)

### 2.4.1 SMEs in the food and drink supply chain

Given the importance of SMEs in all parts of the food and drinks supply chain, shown in Figure 15 below, a key consideration in the research is the opportunity that Lean thinking presents to promote resource efficiency in smaller businesses. Therefore consultants from Brook Lyndhurst, part of the project team, conducted supplementary research targeted at food and drinks SMEs. The aim of the exercise, which involved in-depth qualitative interviews conducted in March 2013 with 16 SMEs from across the UK food and drink supply chain, was to better understand the way Lean was being used and how it might map onto resource efficiency for SMEs. Associated barriers or constraints

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\(^a\) WRAP (2010) Securing the future – The role of resource efficiency
were also identified. Key findings from Brook Lyndhurst’s work are embedded at relevant points in the present report.

**Figure 15: Number of SMEs in the food and drink supply chain**

<table>
<thead>
<tr>
<th>Employment size band</th>
<th>Manufacturing</th>
<th>Wholesale</th>
<th>Retail</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4</td>
<td>3,395</td>
<td>1,0720</td>
<td>16,625</td>
</tr>
<tr>
<td>5 - 9</td>
<td>1,335</td>
<td>2,570</td>
<td>4,920</td>
</tr>
<tr>
<td>10 - 19</td>
<td>905</td>
<td>1,610</td>
<td>1,440</td>
</tr>
<tr>
<td>20 - 49</td>
<td>695</td>
<td>885</td>
<td>510</td>
</tr>
<tr>
<td>50 - 99</td>
<td>325</td>
<td>285</td>
<td>85</td>
</tr>
<tr>
<td>100 - 249</td>
<td>265</td>
<td>160</td>
<td>40</td>
</tr>
<tr>
<td>250 +</td>
<td>215</td>
<td>75</td>
<td>30</td>
</tr>
</tbody>
</table>

Source: IBDR data (2012)
3 Resource inefficiency in the food industry

3.1 Overview

Before looking at the role that Lean can play in the food and drink industry, it is important to understand in more detail the type of resource inefficiency (savings opportunities) that currently occurs\(^a\). Many positive steps have been taken in recent years to make the industry more efficient, yet many opportunities remain.

Section 2 detailed the amount of waste produced in the food supply chain and the headline £1 billion value of the opportunity to reduce this waste in the food and drink manufacturing sector alone. This section of the report focuses on the detail on resource inefficiency in the food retail, manufacture, distribution and hospitality supply chain. In addition, the issues underlying much of the sector’s inefficiency are identified. To appreciate the level of benefits that Lean could bring, it is important to identify and understand these causes of waste – and their associated environmental impacts.

3.2 Causes of waste

Retail, manufacturing, distribution and hospitality are inextricably linked in the food and drink supply chain, therefore many of the causes of waste are relevant to all these areas. Key causes of product and resource waste include:

- forecasting inaccuracies
- on shelf availability (OSA) demands
- new product development
- product ranges and promotions
- poor stock turns
- packaging specification
- water inefficiencies.

Businesses are striving to improve the accuracy with which they forecast customer demand and manage stock and distribution. They are also working on technologies and techniques to extend shelf-life, which enables savings to be made along the supply chain. Packaging improvements contribute to better transport efficiency, whilst water use is improved dramatically by the use of sub-metering. These areas are discussed in more detail in the following sections.

3.2.1 Forecasting

One of the key causes of waste throughout the supply chain is out-of-date (OOD) product as a result of inaccurate forecasting. Notoriously difficult to manage, forecasting demand is a complex operation. Retailers put themselves and their supply chain under intense pressure to provide customers with excellent availability of thousands of products, or stock keeping units (SKUs), all year round, 24 hours a day. Given that customer demand can be unpredictable, retailers will accept a level of over-supply (and the waste that inevitably results) to avoid empty shelves and customer dissatisfaction.

\(^a\) This section is informed by the evidence provided in Phase 1 of this project (see Appendix 6)
Shelf life plays a significant part in the levels of date-expired wastage; Table 6 shows that the product categories with a short shelf life, e.g. sandwiches, in-store bakery, have a much higher wastage or yield loss than the longer shelf life products, e.g. frozen food. Given an average retail OOD figure of 7%, this translates to a loss of £1.82 billion per year⁶.

**Table 6: Estimated waste levels across retail categories due to out of date products**

<table>
<thead>
<tr>
<th>Category</th>
<th>Estimated level of wastage due to out of date product (by volume)</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Across all retail</td>
<td>6-8%</td>
<td>British Retail Consortium</td>
</tr>
<tr>
<td>In-store bakery</td>
<td>6-10%</td>
<td>Industry estimate</td>
</tr>
<tr>
<td>Sandwiches</td>
<td>5-8%</td>
<td>Industry estimate British Sandwich Association</td>
</tr>
<tr>
<td>Fish</td>
<td>Fresh 5% Frozen 1%</td>
<td>BFFF WRAP</td>
</tr>
<tr>
<td>Fresh produce</td>
<td>5%</td>
<td>Industry estimate WRAP</td>
</tr>
<tr>
<td>Meat</td>
<td>4%</td>
<td>WRAP: Red Meat Supply Chain</td>
</tr>
<tr>
<td>Ambient products</td>
<td>2-5%</td>
<td>Industry estimate</td>
</tr>
<tr>
<td>All frozen food</td>
<td>0-1%</td>
<td>BFFF</td>
</tr>
</tbody>
</table>

*Source: Oakdene Hollins, from industry sources/communications*

The last decade has seen improvements in forecasting techniques using automated replenishment software. This has largely been limited to ambient and chilled product; the next steps are to apply this to in-store products, such as bakery and fresh produce. IBM’s 2011 report⁷ estimates that 50-60% of a supermarket’s revenue is from chilled products. Forecasting and waste minimisation in these categories is difficult due to perishability and short-shelf life of products, but high sales of these items mean that any improvement, however small, reap large financial benefits.

In the hospitality sector, forecasting in the form of menu-planning is the cause of much waste. In a school, for example, food delivered to kitchens may not match the pupils’ preferences for that day, leading to wasted product, wasted transport and wasted energy in keeping the food warm. Hospitals have trialled many different ways of improving menu planning. Automated electronic tablets on wards allow patients to choose their own food for the day, and nursing staff can amend delivery times to avoid times when a patient is receiving treatment, for example.

Two additional methods of tackling forecasting inaccuracies are:
- lead-time analysis
- order or product classification.

**Lead-time analysis**

For short shelf-life products, forecasting is often required since customer order lead-times are shorter than the combined lead-times of purchasing, producing and distributing the orders. Figure 16 shows an example of lead-time analysis. This shows that the customer order lead-time is three days shorter than the order processing lead-time. It is therefore necessary to forecast three days in advance.

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⁶ 7% of £26bn see Defra Food Pocketbook (2012)
⁷ Planet Retail/IBM (2011) The Challenge of Food Waste
The aim of lead-time analysis is to reduce the length of the forecasting window since the more near-term the forecasting the more accurate it is likely to be. The key questions in this scenario are:

- How can the combined order processing lead time be reduced?
- How can the customer order lead time be increased?

Value stream mapping (VSM) can address both of these questions. VSM is a tool used to identify non-value added activities, in terms of both physical material and information flows, and in both current and future states. In addition, rather than forecasting at finished product level it can be more beneficial to forecast the raw material requirements since there can be a higher guarantee of their use. This is known as a purchase-to-stock system. This system is used in the bulk import of Old World wine where the time taken to ship the wine can be around 15 weeks. Shipping the unblended wine in bulk for blending in the UK can reduce the risks associated with forecasting at finished product level since the unblended wine can be used in a number of different products. If bottled at source, the 15 week purchasing lead time places a very heavy burden on finished product forecasting.

The ideal scenario is where the order processing lead-time is shorter than the customer order lead-time since this eliminates the need to forecast, and a make-to-order system can be adopted.

**Order or product classification**

Demand amplification and the difficulties associated with schedule of supply and production to meet demand is a cause of increased production costs. Demand can be erratic with peaks and troughs commonplace within most organizations. These variations are amplified within the supply chain when re-orders are made; this is then cascaded through the tiers of the supply chain (distributors, manufacturers, raw material suppliers). Accommodating these fluctuations increases waste/costs by building inventory and lengthening lead times.

A popular means for manufacturers to manage forecasting uncertainties/demand amplification is by using the runners-repeaters-strangers technique. This works on the principle that the vast majority of products are runners; that is, they are standard products where customer order patterns are...
predictable. This means they can be made, with minimum risk, using historic order data. Repeaters are standard products which are less frequently required and hence accurately forecasting demand is harder than for runners; and strangers are customised, rarely required products that are almost impossible to predict.

This approach avoids treating all orders as strangers, i.e. in a very reactive manner where a high level of expediting is required to get orders delivered on time and in full. Isolating the orders that can be classified as strangers can provide negotiating power, as the manufacturer can command higher prices to offset production disruption. Organising core processes to handle the runners efficiently will reduce costs and improve demand flows.

3.2.2 On shelf availability

One of the main considerations for retail ordering is the perceived trade-off between wasted product (OOD) and on-shelf availability (OSA) and this is viewed with a high level of inevitability among many in the industry. However, a report by the Food Chain Centre at IGD found that the supply chain that achieved the lowest waste also had the superior OSA.

Whilst better forecasting methods will undoubtedly help, this Food Chain Centre study also identified back-of-store disorganisation to be a major contributing factor:

“A major opportunity to contribute to this in retail is between the back door and shelf, where back of stores were observed to have disorderly storage and handling leading to congestion, temperature discrepancy, damaged product and difficulties in locating required products. Some store managers claim that back-of-store problems are created due to lack of space and increasing product ranges. However, there is a striking improvement in stores where existing space is planned well and standard operating procedures are applied rigorously.”

In both the hospitality and retail sectors, pub or restaurant chains have tried to maximise the revenue-generating front of house selling space at the expense of back room storage. Unless the remaining back room area is extremely well planned and organised, the likelihood of stock shortages and stock outs increases.

The IGD report also found that systems to measure OSA varied in their accuracy and effectiveness. Some retailers measured OSA through continuous real-time shelf inspection, whilst others did so by calculating the time from the last sale of a product until the shelf was replenished. IGD estimates that the top 200 product lines run at an OSA of about 97%. Chilled products such as red meat achieved nearer 90% OSA. The conclusion was that if red meat OSA could be improved to nearer the 97% level, the result would be a 1.75% improvement in sales, taking all factors into account. For a retailer, this figure is significant.

3.2.3 New product development

Mintel’s NPD Database reports that:

“The UK food and drink industry has the highest number of new product variant launches outside the US. Between 2005-2011 (up to October), UK manufacturers

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[a] Food Chain Centre (2007) Applying Lean thinking to the meat industry
launched 49,995 product variants compared to 47,677 in Germany, 41,005 in France, 36,652 in Brazil, 32,019 in Japan, 24,209 in Spain and 13,868 in Canada."

A complex, ever changing product range places huge pressure on a manufacturer’s production lines, since many have to accommodate the whole range on no more than 10 production lines. This can lead to high levels of production changeover waste; the waste created when a production line is switched from producing one product to another. In addition, a large product range places a heavy burden on a company’s stock management system. A sudden decision to de-list or change a product can generate high levels of obsolete stock (raw materials and packaging). Therefore, ‘agile’ manufacture is a key requirement of any food and drink manufacturing company; enabling the company to respond quickly to any product changes imposed on them.

### 3.2.4 Promotions activity

Second only to price, promotions are the most important factor influencing customer’s choice of product (Figure 17). Therefore, from a Lean ‘customer value’ perspective, promotions are a key activity.

![Figure 17: Factors influencing consumer product choice](source: IGD ShopperVista 2012)

However, promotional activity can cause significant disruption to manufacturers’ master schedules; it can increase the risk of manufacturers or regional distribution centres (RDCs) being left with unused stock, or supermarkets running out of products on shelves.

Every day low price (EDLP) is the alternative approach to the high-low ‘promotions driven’ pricing strategy, and the merits of the two systems remains a highly debated topic in the retail industry. EDLP gives credible consistent pricing by offering products at a consistently low price, whilst high-low pricing slashes prices during short-term promotions. EDLP is integral to Wal-Mart’s pricing strategy in the USA, and is taken up by its UK subsidiary ASDA under its ‘Price Guarantee’ promise. Tesco, on the other hand, prefers the high-low promotional approach, arguing that EDLP is ‘boring’ and fails to enthuse customers.
Wal-Mart maintains that EDLP is only possible with an accompanying every day low cost (EDLC) approach; the supply chain must be the most efficient it can be to drive down cost. Long-term offers on multi-buys and pricing roll-backs lead to more predictable demand forecasting for suppliers, who also then do not have to factor in price/packaging label changes. Offsetting low margins with efficiency gains is crucial for the success of EDLP.

With high-low pricing, supermarkets do not attempt to offer the absolute lowest prices on a daily basis, but attract customers to stores in search of unbeatable short-term bargains. Through promotions and product line changes, the retailers seek to ‘delight’ customers by frequently changing the look and nature of products to maintain an aura of authenticity and novelty. This activity needs to be managed carefully to prevent stock becoming unusable in the supply chain. Promotions usually require manufacturers to produce large quantities of stock up-front. Given a low probability that customer demand will match supply, significant waste can result; especially if products have a short shelf-life. Although collaborative planning can help alleviate some of these issues, in reality the secretive nature of promotional activity - and need to respond quickly to other retailer promotions - means that there is rarely opportunity for such planning.

Although EDLP and high-low pricing are opposing strategies, they both rely heavily on increased supply chain efficiency to make them work well.

AMG Strategic Advisors, a leading sales and marketing agency in the consumer packaged goods industry, recently released the results from its trade promotion study, *A Shift in the Lift: A Study of Key Factors Influencing Trade Promotion Effectiveness*. It concludes that trade promotion is no longer generating the same level of promotional lift. Shoppers are making fewer impulse purchases and often expect to find their favourite items on promotion. Retailers are evolving to more complex EDLP and Hybrid EDLP strategies, and seeking new ways to increase customer spend.

3.2.5 Poor stock turns

From a Lean perspective, holding stock in retailer warehousing is regarded as a non-value-added activity. Inventory or stock turn is a commonly used key performance indicator (KPI) to establish the efficiency of moving product through this stage in the supply chain. This is calculated as:

\[
\text{Number of inventory/stock turns} = \frac{\text{cost of goods sold}}{\text{average inventory value}}
\]

The higher the stock turn figure, the faster stock moves through the supply chain and the more efficient the process. McDonald’s, for example, has a stock turn of 140.47. This translates to the entire stock being cleared every 2.59 days - incredible even for the high-turnover fast food industry.

Figure 18 shows inventory levels in terms of the average number of days’ stock held in UK retailer warehousing. For frozen and slow-moving groceries a distinct reduction in the number of stock days can be seen between 1996 and 2004 but this is more erratic from 2005 onwards. For fast moving groceries the trend is less pronounced, and in 2010 industry average warehouse stock level for fast moving groceries was 9.7 days, which appears high given the nature of these products.

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a Berg N & Roberts B (2012) *Walmart: Key insights and practical lessons from the world’s largest retailer*, p.54
b Acosta Sales and Marketing (2013) *Trade Promotion Effectiveness: A shift in the lift*
d Calculated by: number of days per year (365) ÷ annual stock turn figure (140.47) = 2.59 days
One possible reason for this is that a call-off system is typically used. This system means that large quantities of products are sent to regional distribution centres (RDCs) from which products are delivered to retail stores. The quantity of products received by RDCs is based on expected or forecasted demand. The call-off system means that retailers can either request delivery of these goods at any time (i.e. ‘call-off’ the products), or choose not to receive these goods at all (if, for example, demand for a particular product is not as high as expected.) This allows retailers to react quickly to fluctuations in customer demand without having to store large quantities of goods in stockrooms on site. However, using a call-off system can result in the build-up of products at RDCs if they are not ‘called off’ in the expected quantities, and at the expected times.

*Figure 18: Average retailer warehouse stock levels (days) by grocery category*

3.2.6 Packaging

Packaging performs a very important function in protecting a product, extending product shelf life and minimising waste by limiting product damage as it passes through the supply chain. However, opportunities to reduce unnecessary packaging should be considered, given the volumes of packaging waste produced each year. Retailers produced 1,046,000 tonnes of packaging waste in 2008, with manufacturers producing 406,000 tonnes and distributors 85,000 tonnes. Packaging formats used in the supply of raw materials to food manufacturers is a particular opportunity for packaging reduction, with many high-volume ingredients currently delivered in small 25kg packages. Alternative systems include the use of bulk systems to save on secondary/tertiary packaging; or, where feasible, for a lighter grade cardboard or returnable transit packaging (RTP) system to be used in place of heavy corrugated board.

3.2.7 Water

Many of the processes in a food supply chain involve the use of water, whether for cleaning or as an ingredient. The large users of water are those involved in the manufacture of drinks (such as breweries, distilleries, dairies, soft drinks producers) although, as Figure 19 shows, 56% of water used in the industry was used by other non-drinks companies.

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*WRAP (2010) Waste arisings in the supply of food and drink to UK households*
Water is generally less expensive than energy for companies to procure, and so the focus has largely been on energy efficiency and waste prevention. However, as the costs of water are rising, it becomes a more precious resource to conserve. WRAP’s report on the drinks industry\(^a\) shows that a 10% reduction in water use would translate into a £2.1-£6 million financial saving, with an associated environmental saving of 2 MtCO\(_2\)e. The use of sub-metering has been identified as key to reducing water use, simply by making organisations aware of the location and extent of their water usage.

3.3 Lean and waste minimisation

Improving the resource efficiency of the food and drink supply chain, especially cutting food and packaging waste, presents an important opportunity in increasing profitability and decreasing environmental impacts. A key challenge is the varied nature of these impacts and the trade-off between guaranteeing customer choice while minimising unnecessary stock and avoidable waste.

Lean methods are widely used in many industries to reduce financial costs of production, and respond to challenges such as these. It is also increasingly recommended as a vehicle for simultaneously reducing resource use. Section 4 introduces Lean as a method for eliminating waste, and outlines some its key principles.

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\(^a\) WRAP (2010) Drinks Resource Map
4 Introducing Lean thinking

4.1 The definition and history of Lean thinking

Lean has been described as “pursuit of perfection by constantly eliminating waste through problem-solving”, waste being any activity not adding value to the customer.

In practical terms, it is a business improvement method that provides a way of doing more by using less: less energy, less effort, less time, less material, less water, less space.

The principles of Lean as understood today originated in the automotive industry. In 1913 the Ford Motor Company developed a new way to integrate the automobile production process. Ford’s competitors operated with general purpose machines, grouped by process, and requiring many stages of sub-assembly before the final product was complete. Ford introduced the idea of ‘flow production’ by lining up construction steps in sequence to create the moving assembly line. Special purpose machines and ‘go/no-go gauges’ speeded up inspection (permitting in-line inspection) during assembly of components which allowed the manufacturing process to quicken and flow; inventory stocks were turned around every few days. A key drawback was that Ford was unable to provide customers with variety; all vehicles were the same colour and to the same specification. The problem was faced by other auto manufacturers that adopted Ford’s model. The industry responded by increasing product ranges which added to the complexity of production systems. The need to offer customers variety also meant larger machines and inventories, slowing throughput. In time, the essence of Ford’s ‘flow production’ concept was lost.

In the 1950s, Eiji Toyota of the Japanese automotive manufacturer Toyota revisited the original Ford concepts, but understood that the demand was for smaller quantities of cars produced in many varieties rather than for high volume, identical vehicles. Toyota recruited a team led by Taiichi Ohno to change the production process at Toyota to combine the benefits of flow production with variation in product output. In so doing, they created the Toyota Production System (TPS), still in use today. To ensure quality, Ohno introduced self-monitoring machines to the factory layout developed in Ford’s ‘moving assembly’ line and emphasised quick set-ups enabling each to manufacture small volumes of various parts. Crucially, each process step notified the previous step of its need for supplies, ensuring effective flow of material; thus, the ‘pull production’ concept was created. The TPS is grounded in the philosophies of Jidoka (a quality control process) and ‘Just-in-Time’ (JIT) (making only what is needed when it is needed), allowing Toyota to meet customer demand for the quick and efficient production of a variety of vehicles with ensured quality.

Toyota’s way of working relies on continuous development and a focus on innovation, facilitated by employee participation and creativity. Any workplace practices proving successful are then institutionalised. This philosophy, which required a ‘culture change’ across the organisation, gave the company a significant competitive advantage and accounted for its global success. Toyota’s approach has since been adopted by many other companies and industries worldwide, and in time was re-labelled as the ‘Lean manufacturing system.’

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a Jeffery Liker and Mike Rother. nd. Why Lean Programs Fail. Lean Enterprise Institute. Available at: http://www.lean.org/whatslean/history.cfm
A A history of Lean. Available at: http://www.lean.org/whatslean/history.cfm
d A brief history of Lean manufacturing. Available at: http://www.beyondlean.com/history-of-lean.html
e Loosely translated as “automation with a human touch”

The Toyota Production System, Available at: http://www.toyota-global.com/company/vision_philosophy/toyota_production_system/
One of the success factors of Lean is that it can be applied to any type and size of organisation – it is highly adaptable. Its most up-to-date use relates to the ‘Leaning’ of entire supply chains, involving many different businesses of all sizes.

**Lean concept**

Lean is often understood today as a way to reduce operational waste. Here the term ‘waste’ is defined as any activity which does not create value as perceived by the end customer. It thus includes any use of resources (e.g. cost, time, movement, materials, energy, water, etc.) The core idea is to maximise customer value through minimising waste.

James P. Womack and Daniel T. Jones have done much to popularise Lean in the West, introducing the term in their 1990 book *The Machine That Changed the World* (co-authored with Daniel Roos). In a follow-up publication, they outline the principles of Lean:

1. Specify what creates value from the perspective of the customer (and so what can be deemed ‘waste’).
2. Identify and understand all the steps along the value stream, in order to highlight non value-adding waste.
3. Make the processes identified above flow - i.e. without disruption, waiting time or scrap.
4. Make only what is *pulled* by the customer i.e. creating what’s needed when it’s needed by the customer.
5. Strive for perfection by continually removing wastes.

While Lean thinking remains largely the preserve of manufacturers, experts insist that these principles can be extended to any kind of business; the Lean philosophy is now found in other sectors including retail, logistics and public sector service provision.

### 4.2 Benefits of Lean

The key drivers for implementing Lean in an organisation can be identified as:

- cost reduction
- quality improvement
- the developing of efficient processes
- variation reduction.

Implementing Lean can have significant quantitative impacts for an organisation, including an increase in operating efficiency, and reduction of throughput times and inventories. Productivity will also increase, as reduction of the Lean wastes will allow business to run at capacity, reduce costs and defect rates. Ultimately this will reduce the number of errors reaching customers. These benefits are relatively easily seen, but there are a number of broader benefits of Lean implementation including:

- decrease of work in progress and associated costs
- increased customer satisfaction due to on time delivery of services or goods and a more consistent level of service
- consolidation of product service lines and department resulting in more standard processes and reduced variability.

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[a](http://www.lean.org/WhatsLean/)
All of these benefits are tangible and can be measured, allowing organisations to identify specific, measurable improvements that have been made through Lean implementation. Metrics may include financial savings, reduced lead times or reduced inventory. Lean implementation can also have qualitative impacts involving ‘human elements’ and, most importantly, can result in a new culture of continuous improvement embedded into daily operations.

4.3 **Lean tools**

4.3.1 **Introduction**

As many Lean practitioners will stress, Lean thinking cannot be reduced to a set of techniques. Nevertheless, many ‘Lean tools’ have been developed to identify and eliminate waste and thus to increase the efficiency of business operations. These tools can be categorised according to whether they are used for assessment, monitoring or improvement (Table 7).

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Monitoring</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Analysis</td>
<td>Benchmarking</td>
<td>SS</td>
</tr>
<tr>
<td>Process Mapping</td>
<td>Workplace Audit</td>
<td>Control Charts</td>
</tr>
<tr>
<td>Value Stream Mapping (VSM)</td>
<td>Competency Framework</td>
<td>Rapid Improvement Events</td>
</tr>
<tr>
<td>Six Sigma</td>
<td>Kanban</td>
<td>Kaizen Events</td>
</tr>
<tr>
<td></td>
<td>Key Performance Indicators</td>
<td></td>
</tr>
</tbody>
</table>

Source: Adapted from Radnor, Z. (2012), Why Lean Matters, p15

These tools are often used independently but a combination can be ideal, allowing organisations to better evaluate situations and identify improvement potential. These tools are adaptable and can therefore be used by organisations of all sizes and across all sectors, although some (e.g. Six Sigma) may be better suited for larger, data-rich businesses. The following sections provide a brief explanation of the most commonly used Lean tools.

4.3.2 **Kaizen**

*Kaizen* is the Japanese word for ‘improvement’, and a ‘kaizen event’ (also known as a ‘kaizen burst’ or ‘blitz’) is a focussed improvement project to cut waste from a specific part of the process. Given the short time frame, the emphasis is on taking action rather than in-depth analysis of problems. A kaizen event does not allow for prioritising of opportunities and so, for best results, should be used once value stream mapping (VSM), or an equivalent assessment exercise, is undertaken.

4.3.3 **5S**

The 5S tool or methodology is often used to pilot Lean across an organisation. It is a project-based tool focusing on organising, standardising and improving the manufacturing process through better housekeeping. Visual cues are used to achieve more consistent operational results. The 5S pillars, Sort (Seiri), Set in Order (Seiton), Shine (Seiso), Standardise (Seiketsu), and Sustain (Shitsuke), provide a methodology for organizing, cleaning, developing, and sustaining a productive work environment.

The five rules are as follows:
1. Always keep the work place tidy.
2. Make signs visual.

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apelink: [http://www.epa.gov/lean/environment/methods/fives.htm](http://www.epa.gov/lean/environment/methods/fives.htm)
3. When you remove something, put it back to its origin.
4. Switch off all electrical appliances and water taps when not in use.
5. Keep all your work materials next to your work station.

4.3.4 Standard operating procedures

Any process that is allowed to operate in an uncontrolled manner will inevitably produce variations in the products it generates. This can lead to out-of-specification products which have to be discarded or reworked. Much of this variation comes from different working methods employed by different people or shifts. By following a documented, clear standard operating procedure (SOP), all workers can ensure consistency of approach.

The introduction of SOPs is needed at the point when a company grows larger and cannot rely on the owner or manager to notice differentiations in working practices. SOPs can be periodically updated to take account of improved processes. In this way continual improvement is embedded into the fabric of the company.

4.3.5 Six Sigma and DMAIC

Six Sigma is a set of statistical methods to analyse processes and reduce process variation. These techniques can be used to assess process quality and identify wastes to which other Lean methods can be applied. The implementation of Six Sigma as part of a Lean methodology, at site or enterprise level, requires a large organisational change. As a series of tools alone, Lean Six Sigma is unlikely to yield maximum benefits. Integration with a robust change management strategy may increase success. As an example, Figure 20 shows how ADKAR, a change management model, is linked into the Lean Six Sigma’s Define, Measure, Analyse, Improve and Control (DMAIC) phases.

![Figure 20: Links between DMAIC (Six Sigma) and ADKAR (Change Management)](http://www.change-management.com/tutorial-case-study-ssl.htm)

4.3.6 Value stream mapping

Value stream mapping (VSM) provides a view of an entire process, helping those involved to recognise what is actually happening, to highlight sources of waste, and to plan future improvements. A value stream map is a high-level visual depiction of all the activities involved in delivering goods or services to the customer. Identifying the value stream will reveal those activities which are non-value adding (i.e. wasteful), and can therefore be eliminated. VSM is often considered the most important first step towards the implementation of Lean, and can be extended beyond

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a [http://www.epa.gov/lean/environment/methods/sixsigma.htm](http://www.epa.gov/lean/environment/methods/sixsigma.htm)
b Jim Womak and Dan Jones (2003), *Learning to See* (Foreword)
the boundaries of a specific company to entire supply chains. By understanding the relationships which exist within their supply chain, organisations can identify where effort should be focused to encourage further process improvements.

Some academics and consultants propose a sustainable value stream map (SVSM) or environmental value stream map (EVSM) as a way of aligning economic or environmental impacts.

### 4.4 Lean and resource efficiency

#### 4.4.1 Bridging the gap

According to Lean thinking, the so-called ‘Seven Deadly Wastes’ in a process or supply chain should be identified and systematically eliminated. This approach has undoubted synergies with the drive to reduce resource use and environmental waste. There is some debate on whether sustainability imperatives can be fully integrated into traditional Lean/continuous improvement approaches, or whether there should be a ‘green’ variation of Lean.

The US Environmental Protection Agency (EPA) is one of the first to recognise this potential marriage of Lean and resource efficiency, and has undertaken much work in this area. The EPA has used Lean in its traditional sense, linking it with environmental impacts (Table 8):

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

Source: EPA from [http://www.epa.gov/lean/environment/toolkits/environment/ch2.htm](http://www.epa.gov/lean/environment/toolkits/environment/ch2.htm)
It is clear from Table 8 that the Lean approach is highly compatible with the goals of waste minimisation, pollution prevention and sustainability in any given industry. As Dües et al (2013) note, “The business environment created using Lean practices can rather be described as the perfect background for implementing Green practices”.

Other approaches to Lean and the environment have centred on variations of traditional Lean to make it more specific to sustainability concerns. Environmental Performance Indicators (EPIs) and Sustainable VSM (SVSM) are two such examples. The choice of which approach to use often depends on the maturity of a specific industry in its use of Lean. The more knowledge there is of Lean, the more likely that green variations will be embraced. An industry at the start of using Lean may be better implementing traditional Lean first, given the significant resource efficiency benefits that can be achieved.

A more pressing concern may be the quantification of environmental savings; whether they fall out from a commercial Lean project, or are the end goal in themselves. Since the improvement of environmental performance is rarely part of the business case for Lean projects, organisations may not quantify the associated resource efficiency savings. Environmental benefits may be a by-product of actions focused on reducing the time or financial costs associated with a product or process. Real world evidence supporting the environmental benefits of Lean has therefore, until recently, been lacking. The question remains as to whether organisations should drive resource efficiency through a Lean focus at all, or whether such improvements should stay part of pre-existing environmental or pollution prevention strategies (e.g. environmental management systems (EMSs), CSR activities, etc.).

Yet both approaches may yield environmental and efficiency improvements; environmental wastes represent a cost to an organisation, so tackling them should be an explicit target of Lean. Lean may identify hidden wastes and risks. For instance, Boeing’s Lean approach saw improvements in resource efficiency of between 30-70% and decreased the per-plane use of chemicals by 12%. At the same time, pro-environmental activities may reveal areas overlooked by Lean. For instance, better waste segregation stemming from an EMS at a manufacturing company may provide useful information to targeting material waste through Lean.

4.4.2 US EPA: Linking Lean and Green

As previously mentioned, the US EPA is pioneering the links between Lean thinking and environmental improvement. Pure sustainability initiatives often fail to compete for the management time and resources needed to carry out projects, despite the proven benefits they bring. Given the resistance that many organisations have towards strict government legislation, the EPA believes that in some situations Lean may be more effective than regulation in conveying sustainability messages. If Lean practitioners can see the business value in including environmental initiatives in their Lean practices, more environmental improvements may result.

The long-term aspiration of the US EPA is that environmental considerations become incorporated within Lean, without the need for toolkits and a separate focus. In the meantime, given the

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(b) http://www.epa.gov/lean/environment/toolkits/environment/ch2.htm

possibility of significant environmental gains, the US EPA is acting to accelerate the process in American manufacturing and service industries. Its stated aims are to:

- raise awareness about the relationship of Lean production to environmental improvement;
- share good practices for improving the environmental benefits of Lean initiatives;
- develop and disseminate integrated Lean and environmental tools; and
- identify and address environmental regulatory considerations associated with Lean.

**Silo working: Involving environmental practitioners**

In many organisations, environmental managers and those implementing Lean work in isolation from one another. This seems especially true for organisations in the early stages of Lean implementation where the associated concepts may be unfamiliar to environmental practitioners. Lean implementation can have clear resource efficiency benefits, and yet Lean as a tool may not be used beyond simple one-off problem-solving. To bridge this gap between environmental and Lean activities at a facility, the US EPA published *Lean Manufacturing and the Environment* in 2003, which suggests strategies by which environmental professionals and Lean practitioners can better communicate with each other. Ideally, these functions should be integrated with EMS objectives which are aligned with lean initiatives and operational business goals.

Recognising that language and terminology present a barrier between environmental and Lean practitioners, the US EPA produced the *Environmental Professional’s Guide to Lean and Six Sigma* in 2009 which introduces the branding ‘Lean and the environment’. This helps the two business functions integrate and support each other, and again communicates the message that reducing environmental waste can be aligned with broader business aims and offer cost savings. In the Guide, environmental practitioners are recommended to re-label ‘environmental waste’ as ‘process or material waste’, phrases to which operational managers may be more able to relate.

The US EPA’s Lean and Environment initiative offers numerous case studies and guidance for organisations wishing to eliminate environmental wastes, while acting in alignment with Lean initiatives. This material, freely available on the US EPA’s website, is aimed at all operatives; from Lean operational managers to environmental and Lean practitioners. The Lean and Environment Toolkit includes Lean tools such as VSM and Six Sigma which are modified to include environmental considerations.

Models such as these give companies an overview of Lean tools, allowing these to be implemented as they see fit in their own businesses. The toolkits are not tailored to specific industry sectors but provide an overview of all sectors with specific cases highlighted across various industries. The US EPA participates in Lean events and conferences and invites companies to share their experiences of the integration of Lean and environmental activities.

### 4.5 SMEs and Lean

SMEs make up much of the food and drink supply chain (see Figure 15 previously) and so any initiative to reduce waste in the industry should be able to engage with small businesses. There is much published research on SMEs and their attitude towards the environment and resource efficiency. Much of this suggests that the majority of SMEs are not interested in environmental or

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a [http://www.epa.gov/lean/environment/basic.htm](http://www.epa.gov/lean/environment/basic.htm)
c [See: http://www.epa.gov/lean/environment/toolkits/environment/ch3.htm](http://www.epa.gov/lean/environment/toolkits/environment/ch3.htm)
d Lean manufacturing and the environment Toolkits. Available at: [http://www.epa.gov/lean/environment/toolkits/index.htm](http://www.epa.gov/lean/environment/toolkits/index.htm)
resource efficiency concerns, and show little willingness to engage in improvements; even if they do want to engage, they face very significant operational and capital investment barriers.

As evidenced later in the report, research interviews for this project found that this was not always the case, however. Or, at least, it may rather be that SMEs have been looking at the question from the wrong end. That is, the focus on SMEs has historically been on managing their environmental impacts by introducing new technology and processes. A better focus area might be on optimising business and production processes (i.e. Lean approaches). This opens up opportunities for improving resource efficiency that might not otherwise be revealed. The case argued for Lean and Environment by the US EPA provides a good example of the latter perspective.

Existing literature on resource efficiency and SMEs tends to simply acknowledge the difficulties faced by SMEs in this area, and the problems in reaching these organisations with targeted advice. This current study suggests that SMEs may be better supported via process optimisation as a way of drawing out resource efficiency improvements. This builds on the research undertaken in a report by Brook Lyndhurst and Entec for WRAP on SME behaviour and resource efficiency, which looked at business competencies displayed by SMEs and whether these did or did not relate to resource efficiency improvements.

SMEs are often put in a single category and analysed as a collective body; however, the size of SMEs is a key factor in their approach to Lean. The reason for this is the lack of quantitative research as to how the size and structure of SMEs influences their behaviour. Much of the recent work has focused on micro businesses (fewer than 10 employees), yet their approach to Lean and resource efficiency will differ significantly from a large SME of 250 employees. There are three significant sub classifications within SMEs:

1. Micro SMEs (fewer than 10 employees) are often under the control of an expert owner, who uses common sense measures to manage costs and efficiency improvements.
2. Medium small businesses (MSBs – 10-100 employees) are starting to need to standard procedures as the owner needs to delegate more
3. Larger SMES (100-250 employees) are most likely to have formalised CI/Lean processes

A key message from the SME interviews undertaken for this report is that many smaller companies do not properly understand customer value in relation to Lean. Customer value is only perceived at the end product stage i.e. in the final offer to the customer. Lean changes this perception of value to looking at any activity in the entire supply chain - would a customer be willing to pay for this activity? So, a customer would generally not be willing to pay for product to be waiting on a shelf for 3 days, but would be prepared to pay for the process of getting the product properly packaged. Changing the way SMEs understand customer value, from a traditional view to a Lean view, is an important step for the industry.

4.6 Lean versus Green

4.6.1 Introduction

The limited evidence available suggests that Lean or Lean-like principles are likely to improve resource efficiency in the UK food and drinks supply chain, although - as discussed in Section 4.4.1 - the environmental benefits are often a by-product of actions taken to improve process efficiency. Against these likely synergies, there should be recognition of the potential conflicts that could arise between Lean and resource efficiency. The US EPA notes that the implementation of Lean was most difficult in environmentally sensitive areas, as highlighted in its case study on its Boeing operations. Unfortunately, few quantified examples of ‘Lean versus Green’ have been published, but the
following sections review situations where Lean thinking may, in theory at least, conflict with environmental imperatives.

4.6.2 Just-In-Time

Just-In-Time (JIT) is defined as an “inventory strategy companies employ to increase efficiency and decrease waste by receiving goods only as they are needed in the production process, thereby reducing inventory costs”. This Lean principle may sometimes conflict with environmental goals. For instance, in the automotive sector, the air pollution resulting from painting cars might be reduced by painting larger batches of vehicles in the same colour. This conflict with JIT principles, favouring smaller batches in order to better respond to customer pull.

JIT also encourages an increase in replenishment frequency by favouring the frequent delivery of smaller batches of products, or raw materials, over infrequent delivery of larger consignments. The transportation of smaller, more frequent batches may generate relatively more transit packaging waste, unless a re-usable transit packaging system is adopted. Moreover, while greenhouse gas emissions associated with storage may be lower in a JIT supply chain due to lower refrigeration requirements etc., frequent replenishment may increase transport-related emissions. In longer supply chains, transport emissions may outweigh any savings achieved from reducing inventory (Figure 21). According to one academic, companies with advanced Lean processes (primarily those in the automotive sector) will establish a system of distribution hubs or ‘milk rounds’ (i.e. supplying multiple customers on the same route) to offset this problem. In addition, JIT production may encourage the use of local suppliers, which would reduce associated transport costs and emissions and be a more sustainable solution.

Figure 21: Greenhouse gas emissions as a function of distance in a JIT supply chain

![](image)


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a [http://www.investopedia.com/terms/j/jit.asp#axzz2I5Z9rEZi]


d Personal communication, September 2011
The Lean principle of producing in smaller batches may also result in more frequent changeovers during manufacture. Tools such as ‘single-minute exchange of dies’ (SMED) can accelerate changeovers but the amount of cleaning products required is increased, as – potentially – are the volumes of unused process material.

4.6.3 Clean in Place

Food safety and hygiene regulations oblige food and drinks manufacturers and distributors to ensure that any equipment (e.g. pipes, storage vessels, mixers, boilers, etc.) coming in contact with ingredients and products destined for human consumption is regularly sanitised. Although companies would do such cleaning anyway, the regulations act to underline not only the importance of germ control, but also the minimising of cross contamination for allergy sufferers.

To minimise interruptions to production and the need for manual intervention, many modern factories employ clean in place (CIP) systems in which rinsing detergents are automatically flushed through process equipment during product changeovers without the need for dismantling equipment. Lean thinking seeks to minimise downtime (i.e. time in which machinery is shut down and products cannot be manufactured) during changeovers and may therefore favour the use of hotter water at high pressure, or the use of higher quantities of caustic soda and other cleaning agents to ensure this. Such actions may result in a net increase in the natural resources consumed per unit of product contradicting sustainability goals. Some of these downsides of speeding up CIP can be at least compensated for by optimising the CIP procedures themselves. Notably, the Carbon Trust has worked with the UK brewing sector in the development of low temperature CIP systems.

4.6.4 Variability reduction

A key aspect of Lean is the reduction of product variability. This can have a direct environmental benefit in, for instance, reducing product giveaway. However, some have suggested that in theory the need for maintaining homogeneity in the quality of products can contradict resource efficiency. The example often provided for this is a factory which leaves a machine running over the lunch break while nothing is being produced. From an environmental perspective this may have a significant negative impact (e.g. in greenhouse gas emissions, energy and water use). However, in terms of Lean this practice is sensible if it avoids product variability, and potentially waste, associated with a machine re-starting in the afternoon. This is a good example of a trade-off between environmental benefits. Unfortunately, no evidence is yet available to test such a situation.

4.6.5 Supply chain challenges

Companies may need to rethink their lowest purchase cost sourcing strategies (i.e. choosing a supplier purely on the basis of cheapest product unit price) in light of mounting fuel costs and CO₂ emissions. A total cost analysis (i.e. an analysis taking into account all fixed and variable costs of a process) could be used to assist with this decision. This analysis will take into account all costs involved in sourcing products, including environmental costs which may otherwise be ignored. An organisation may find that in considering all costs in this way, cheap overseas sourcing may not be as

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b CIP was pioneered in North American dairies in the late 1950s. Source: http://www.foodquality.com/details/article/882833/Integral_Role_for_Clean-in-Place_Technology.html?tzcheck=1
d Personal communication, September 2011
cost effective as first considered. Synergies must be carefully investigated to check that the trade-off between Lean sourcing and environmental impacts is justifiable.

### 4.6.6 Summary

Whilst Lean may appear to be a win-win situation for resource efficiency improvements, this cannot be automatically assumed. As process optimisation and continuous improvement gets ever more sophisticated, there may be increasing conflicts with the environmental pathway. Solving these dilemmas is not straightforward and may ultimately rely on balancing or trading off environmental factors.

Larger organisations such as McDonald’s are used to measuring resource efficiency changes (both positive and negative) resulting from process improvements, whether these be targeted savings or accidental ‘by-products’. If all organisations were to take this approach, on a scale to match the degree of Lean implementation, then environmental impacts could be captured and reviewed post-project. This will provide clarity on any trade-off between ‘Lean and green’; negative environmental impacts can therefore be carefully considered before any further roll-out of the Lean programme.

### 4.7 Drivers of Lean in the food and drink supply chain

Lean has been a revolutionary practice for improving the automotive industry, driven by the need to standardise production and continuously improve existing processes. The food and drink industry has its own set of drivers that encourage Lean. An awareness of these drivers is useful in understanding how the industry views Lean, and in which form it holds most value.

#### 4.7.1 Economic drivers

As discussed in Section 3, the food industry is under pressure to lower costs in difficult economic times. The key drivers for this have been a squeeze on household incomes, greater industry competition, and the imperative to remove costs from the supply chain. Environmental concerns are secondary. Another motivator has been increased energy costs. According to Premier Foods, the rising price of fuel and increasing pressure of levies and legislation has made improving resource efficiency “a top priority” for all food companies. Kellogg’s initiated its Lean thinking programme in response to rising costs of commodities (e.g. raw ingredients), coupled with volatile and demanding market conditions. The same pressures are felt in the foodservice sector; a leading contract caterer contacted for this research claims to have a “very small profit margin” so anything which will reduce costs is important.

As the economy has got tougher, companies have been forced to consider more ways to cut costs. Lean’s emphasis on eliminating anything that does not add value is a way of responding to these financial pressures. Equally, new sales growth in the sector is fairly limited due to reduced consumer spend, so increased profits are increasingly being sought through quality improvements and resource reduction.

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a Mollenkopf D et al. (2010) Green, lean and global supply chains
b Graham Paterson, Group Manufacturing Excellence Manager, Premier Foods, August 2011
c Richard Burkinshaw, European Environmental Strategy Manager & Albert Roch, Kellogg’s Company, October 2011
d Personal communication, November 2011
4.7.2 Supply chain initiatives

A partnership approach
Procurement pressure may also drive the adoption of Lean. Many companies are now being asked to adopt Lean principles by their business customers that want to cut supply chain costs or improve their CSR profile. In the retail supply chain, the driving force comes from the larger multiples. The retailer Marks & Spencer, for instance, is notable for assisting smaller suppliers on their ‘Lean journey’ through practical training, working with Skills Councils to provide additional support and through inspirational visits to ‘Centres of Excellence’.

However, this partnership approach is not always apparent, especially when a power imbalance exists in the supply chain. In a recent survey, 38% of smaller food and drinks manufacturers classed their relationship with the UK’s major supermarkets as “challenging”, while only 10% of larger manufacturers said the same (Figure 22). Supply chain pressure therefore acts as both a driver (engagement by multiples) and a barrier (poor relationship with multiples) to Lean.

There is less evidence from foodservice supply chains, although Government Procurement Standards may offer an opportunity to drive Lean, for example in the provision of catering in schools, hospitals, prisons, defence and so on.

Figure 22: How food and beverage manufacturers describe their relationship with supermarket chain

![Figure 22](image)

Source: Grant Thornton

Supply chain integration strategies for food retailers
Until recently retailers have heavily focused on extending their non-food ranges, developing online and local store formats and seeking economies of scale in procurement. As the recession continues and customer spending slows, supply chain strategy is pushing to the forefront of retailers’ minds; as Table 9 shows, different retailers are taking different approaches to building supply chain efficiencies. However, the aims are similar – to carve out longstanding relationships with suppliers which can provide the food safety, flexibility and agility that most retailers are now seeking. To achieve this demands high levels of efficiency; waste is to be stripped out of the supply chain, driven by Lean techniques and continuous improvement.

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a Louise Nicholls, Head of Responsible Sourcing, M&S, meeting in October 2011
b Grant Thornton (2010) Targeting growth: Challenges and opportunities for the UK Food and Beverage sector
UK retailing has evolved to be value-added; that is, to offer product distinction through appearance or range, whereas discounting and price sensitivity has historically been more prevalent in Europe. This means that where a German retailer, for example, may ‘spot buy’ (i.e. purchase on the open market) commodity products such as apples on the wholesale market, UK chains have to work with specific suppliers so that specification, labelling and branding is consistent. To combine this individuality with low pricing requires a robust and efficient supply chain, in which retailers have close control over co-operation with their suppliers. Consolidation in the food and drink industry and shrinking of the supply market (such as the large meat processor Vion’s exit from the UK announced in 2012) means retailers are looking for new ways to maintain a strong, committed supply chain.

Morrisons’ approach, for example, has been to vertically integrate its supply chain, buying up farms, processors and packhouses. Retail Week comments: “What Morrisons is trying to do is to buy more fresh food directly from farmers than its rivals and give it what it sees as a competitive edge over other retailers. ... This is all part of the objective of Morrisons to provide what they believe to be the freshest food to UK consumers and also an attempt to reduce waste in the supply chain”. In this way, Morrisons can utilise more of the whole crop of fruit or vegetables, or the carcase of meat, thus streamlining the supply chain and reducing waste. The Food Chain Centre’s report on the red meat industry recognises that waste would be cut significantly if a dedicated supply chain were established, as:

“...it would be possible to link the supply of animals to the demand for meat products ... The dedicated farms could be used to supply say 85 or 90% of the retailers’ requirements...”

Vertical integration also increases information flow; for example, by owning the supply chain, Morrisons has full visibility of costs and profits through practices such as open book accounting.

Other retailers have not embraced vertical integration to the same extent, perhaps for some of the following reasons:
- Initial investment costs are significant, at a time when balance sheets are under scrutiny.
- Expertise is needed to integrate a complex operation into the wider business.
- There is a risk of inflexibility in the supply chain – committing to a single supply base may, from time to time, lead to a lack of operational flexibility.

Retailers such as Tesco and Sainsbury’s, although having some degree of vertical integration, have generally preferred to seek out long-term partnerships with key suppliers. Although these suppliers are not owned by the retailers, they effectively function as an extended retailer operation, with an in-depth understanding of the way that retailer operates. The belief is that a joint strategy for systematically eliminating waste and improving the flow of information will lead to reduced costs and progressively enhance the competitiveness of the chain. Table 9 shows the main retailers and their supply chain approaches.

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b Food Chain Centre (2007) Applying Lean Thinking to the red meat industry
Table 9: Supply chain models of major UK food retailers

<table>
<thead>
<tr>
<th>Retailer</th>
<th>Supply chain model</th>
<th>Procurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morrisons</td>
<td>Vertical integration – owns some of its suppliers</td>
<td>Owns farms, florists, packhouses, meat processors, seafood factories etc.</td>
</tr>
<tr>
<td>ASDA</td>
<td>Moving towards vertical integration in produce, meat and drink</td>
<td>Bought International Produce Ltd in 2009; bought a SA wine exporter in 2012.</td>
</tr>
<tr>
<td>Co-operative</td>
<td>Vertical integration in growing/sourcing operations; close partners with other ethical suppliers</td>
<td>Farms 50,000 acres in England and Scotland. Also owns pack houses. Grows its own cereals, fruit and vegetables.</td>
</tr>
<tr>
<td>Tesco</td>
<td>Emphasis on direct sourcing</td>
<td>Close partnerships with key suppliers</td>
</tr>
<tr>
<td>M&amp;S</td>
<td>Emphasis on supplier relationships</td>
<td>Supplier support – workshops, expertise, guidance</td>
</tr>
<tr>
<td>Sainsbury’s</td>
<td>Emphasis on sustainable sourcing</td>
<td>20/20 Sustainability Plan – partnerships with key UK suppliers where possible</td>
</tr>
</tbody>
</table>

Such focus on supply chains drives retailers and suppliers to turn to Lean, or continuous improvement methods, to reduce costs and waste. Although Lean has historically not been used for whole supply chains, the food industry is taking key principles and tools and applying them in a way that drives these supply chain efficiencies.

4.7.3 Perishability of materials

Unlike many other sectors, the ingredients and products handled by food and drink companies are perishable. If ingredients and products are managed, stored and packaged inappropriately, they will be wasted. Similarly, if the supply of food and drink exceeds consumer demand at the point of sale, waste will also likely result. The accurate forecasting of consumer demand is essential (see Section 3.2.1). Given this perishability and the risks of waste associated with overproduction, Lean principles such as inventory minimisation seem to lend themselves to the sector.

4.7.4 Transfer of in-house expertise

IGD led a DTI- and Defra-funded programme from 2002-08 to implement Lean principles in agri-supply chains. Typically lean principles were not being widely applied and used as part of continuous improvement programmes in agri-supply chains. Evidence suggests that larger organisations which have developed Lean in other parts of their operation are now applying it to their food business. For instance, Suntory, the new owners of the soft drink brands Ribena and Lucozade, are now implementing Lean approaches in the production process.

4.7.5 Summary

Having assessed the challenges in the food industry (Section 2), seen the potential for resource efficiency savings (Section 3) and been introduced to the concept of Lean (Section 4), the rest of this report focuses on bringing all these elements together. It looks at the current use of Lean specifically in the food and drink supply chain, assessing the approach companies take to Lean, the tools they use and the benefits they derive from this. This assessment is based on a few published examples on the subject, but also – given the lack of quantifiable data – on interviews with industry and case study examples. This is an important caveat for the remainder of the report, and should be taken as the basis for opening up a discussion on Lean in the food supply chain.

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*Peter Whitehead, (formerly Agri-business Programme Leader, IGD); August 2011*
5 Mapping Lean to the food and drink industry

5.1 Overview

The degree to which businesses in the UK food and drink supply chain have adopted Lean principles varies widely. At one end are companies that have no knowledge of Lean and do not undertake formal Lean projects. At the other end are large organisations which have long been implementing Lean throughout their business, and their suppliers’ businesses, to achieve a culture of continuous improvement.

According to one industry expert, a third to a half of the larger UK food manufacturers already has some knowledge of Lean\(^a\). This is broadly supported by global food supply chain professionals surveyed by IGD in 2007, of whom 29% stated that Lean underpinned their business improvement culture; just 14% reported not ever having had a Lean programme\(^b\). Therefore, while Lean is not an entirely new concept in the food sector, it seems far less embedded than in the automotive industry. Certainly, research undertaken for this report indicates that very few organisations could be described as having undergone a Lean ‘transformation’.

Crucially, there is a lack of quantitative data available for companies to be able to benchmark themselves against others in the industry. This can be explained by the fact that, wary of losing competitive advantage, companies undertaking Lean are usually reluctant to share data. However, some ‘real world’ examples from industry, which can guide industry and policy-makers alike, were available and are presented in the sections below.

In order to try and categorise Lean implementation in the food industry, the project team have used a simple model – the Lean Improvement Pyramid – to map the current scale of activity. This was informed by the analytical and research work undertaken in Phase 1 of this project, which used the PDCA cycle to map companies’ Lean activity\(^c\). To a certain extent, the identification process and Lean tools used by a company gives an indication as to its level on the pyramid.

5.2 The Lean Improvement Pyramid

5.2.1 Introducing the Pyramid

Lean is viewed from several perspectives: as a set of tools; as an integrated approach to problem-solving; as a philosophy or culture within an organisation. Academics and consultants have developed models to characterise a so-called ‘Lean journey’. Typically, a five-step process is put forward, in which an organisation graduates from a ‘Reactive’ state in which Lean activities are isolated, unplanned and \textit{ad hoc}, through to a ‘Way of Life’ in which a culture of continuous improvement is fully integrated (Figure 23).

Another well-known model, this time from the Boston Consulting Group, also categorises Lean as a stepped ‘journey’ (Figure 24). It places a key point of intervention at stage 2 of the 4 step model; value added benefits only start to accumulate once a company reaches this point. The report states that “the majority of food and beverage manufacturers are in this stage”\(^d\).

\(^a\) Personal communication August 2011  
\(^b\) IGD Supply Chain Analysis, Lean Operations Report  
\(^c\) See Appendix 4, section 6.1  
\(^d\) Boston Consulting Group (2010) Lean food-and-beverage manufacturing
Figure 23: The milestones of lean maturity


Figure 24: Stage of maturity in Lean manufacturing: Boston Consulting Group

Source: Boston Consulting Group
One Lean consultancy which takes food manufacturers through five levels of maturity reports that few, if any, achieve the advanced stages of Lean evidenced in the automotive industry and its primary and secondary suppliers. The degree to which businesses in the UK food and drinks supply chain have adopted Lean principles varies widely. In practice, given the variability across the sector, determining where a company is on this path is difficult.

The current research team developed the Lean Improvement Pyramid (Figure 25) as a means of mapping businesses according to their level of ‘Lean maturity’.

![Figure 25: The Lean Improvement Pyramid](source)

This is a practical interpretation of Lean which indicates how it might be made relevant to companies of all sizes and readiness to embrace Lean. This is in contrast to some of the business management literature – typically focused on large companies – which portrays Lean as requiring an all-encompassing cultural and structural change in an organisation. This pragmatic model implies that the application of some Lean approaches or tools to certain processes or operations could be a first step on the road to Lean, particularly for those businesses where ‘full-on’ Lean could be alienating. This includes smaller companies which currently lack the structures and competencies to make the full Lean model work successfully.

The lowest level of the Pyramid broadly mirrors the initial, reactive stages of the Lean journey (Stages I and II); the intermediate level reflects a greater integration of Lean and continuous improvement within the business (Stages III and IV) while, at the pinnacle, businesses have undergone a radical culture transformation (Stage V).

The broad base of the first level indicates the numerous businesses operating at this stage. At the narrow, top end, there are only a handful of fully Lean organisations.

Given that Lean is more a management model than just a series of tools, it would be simplistic to tie specific tools with specific levels of the Pyramid. Although the use of certain techniques can indicate the Lean maturity of a business, it is rather the way in which companies plan and identify issues that

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a Personal communication, August 2011
marks them out at a specific level. For instance, food businesses operating at the project-based problem-solving level are less likely to use a mapping exercise, such as VSM, in their approach, meaning that benefits may not be as long-term as those resulting from a well-planned project.

Many Lean practitioners insist that the greatest gains come from nothing less than a culture transformation with an ethos of continuous improvement – Lean fully embedded in all day-to-day practices\(^a\). But, as discussed in Section 6.2 of this report, this requirement for radical change may be viewed by organisations as so onerous as to dissuade them from embarking on Lean at all.

The message of the Pyramid is that even at lower levels, Lean techniques can be used and worthwhile resource efficiency savings realised. While a fully Lean culture may indeed maximise gains, it is not obligatory.

Each level of the Lean Improvement Pyramid is briefly described below and, following this, practical examples of businesses operating at each level are presented. This builds up a picture of the current level of Lean activity in the industry.

### 5.3 Project-based Problem-solving

Project-based Problem-solving sits at the base of the Lean Pyramid. Here, companies solve specific inefficiencies in their processes which are incurring avoidable financial losses. Lean, or Lean-like, approaches or tools such as SMED, lightweighting and CIP may be used, but often the actions taken are considered to be simple common sense and may not be badged as Lean.

**Absence of problem identification**
Characteristic of this level is the lack of time invested in planning and problem identification. The majority of the time allotted is spent on ‘doing’, rather than planning or measuring.

This contrasts with companies higher up the pyramid. Kerry Foods, a company which has successfully implemented a Lean programme at a higher level, stressed that they used the Plan-Do-Check-Act (PDCA) approach with 70% of time spent Planning (data analysis, identifying root causes, quantifying savings opportunities and prioritising the projects), 20% Doing the work and 10% Checking and Acting\(^b\). This ensures that initiatives tackle the most significant problems and that results and improvements are properly embedded with lasting effects.

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\(^a\) Peter Hines et al. (2011) Staying Lean. Thriving, not just surviving.

\(^b\) Personal communication with a former employee of Kerry Foods, 20.2.13
Lack of resources
At this bottom tier, external consultants may be brought in to drive Lean, or someone in the company may instead choose to address the problem. This will depend on the resources available to the business, and the scale of the perceived problem. Significant resource efficiency savings may be realised but the projects - and often the results - are short-lived and limited to the company’s own processes. The culture of the organisation is generally unchanged, although some point out that such improvements are achievable only with the espousal of senior management, so perhaps even here limited culture change is needed. Many SMEs were found to operate at this level, largely for reasons of budget and knowledge.

5.4 Project-based Problem-solving in practice

5.4.1 Coverage

From the evidence collected in the present study, most food and drinks businesses appear to be project-based problem-solvers (see Appendix 1). This is not to say the companies at this level are not seeking to improve – in fact much activity is present. It is rather the way this problem-solving is approached that is the indicator of Lean engagement. Importantly, a lack of planning or problem identification, leading to a lesser degree of opportunity, marks out companies operating in this tier.

Lean tools in common use at this level of the Lean Improvement Pyramid include kaizen, 5S, kanban and SMED, although - to tackle specific problems - some sub-sectors of the food industry have used Lean-like approaches for decades and have not labelled them as such. For instance, dairy organisations long ago streamlined processes, ensuring milk reached consumers within 24 hours of collection. Similarly, continuous improvement in the lightweighting of packaging has long been demonstrated by Heinz and other food manufacturers, with the support of the packaging body INCPEN and of WRAP. The following sections present other examples of project-based problem-solving which, despite being ‘one-offs’, nevertheless offer significant resource efficiency savings from low-cost, quick win innovations.

5.4.2 Limited problem identification

Without proper analysis of problems, it is easy for companies to throw valuable time and money at problems which turn out to be insignificant in terms of waste. The focus is instead on engineering fixes which come from a fire-fighting approach to problem-solving.

An example of this can be seen at one large UK bakery. The admirable drive to make continuous improvement a central part of their working practices was evident in the weekly CI meeting. The purpose was to go through all the major incidents (high volume product losses) that had occurred the previous week. The action list generated from the meeting was dominated by small scale engineering fixes. Unfortunately, this activity was having very little impact on the company’s Key Performance Indicators, i.e. product yield losses. They had a reliable system for capturing product losses but had no one interrogating the data. An external consultancy recommended that they spent more time analysing the data (all losses rather than just major incidents, over the last year). On doing this they found that major incidences only accounted for approximately 20% of total losses - hence the reason why their CI work was having very little impact on performance. This new process identified a common causative factor (stacks of product falling over – each stack was below the major incident threshold limit and hence was not being picked up on the previous system) and they

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a Evidence from interviews undertaken for this research with 16 SME companies in 2013
b Personal communication with Chris Sturman, Chief Executive, Food Storage & Distribution Federation, August 2011
were able to put a value (annual losses) to this of £360,000. A £40,000 investment was made that resulted in a 20% reduction in overall losses and a payback of less than 6 months\(^a\).

Time spent analysing the flow of product or information at the start of the project is vital for maximising gains from Lean. Project-based problem solving is much more effective when applied to the most significant problem; otherwise it ‘sucks up’ time and resources without justifying the result. This is when management lose interest and employees become demoralised, effectively preventing any further uptake of Lean.

5.4.3 Low cost, easy wins – results from a limited Lean approach

With all the references to the Lean journey and the need for culture change to accompany Lean initiatives, there is a tendency to dismiss the one-off problem solving approach. Whilst there is evidence to suggest that a culture of continuous improvement will embed improvements far more than an isolated Lean project initiative, there is equally evidence that points to success stemming from a limited Lean approach.

In 2006, researchers from the Cardiff Business School looked at Lean initiatives in the UK red meat industry. They reported that even limited implementation of Lean would offer significant economic benefits to the industry\(^b\). The authors described Lean elements as in Figure 26, with ‘Lean Practices’ at the basic level (requiring low investment), ‘Lean Policies’ the next level, and ‘Lean Philosophies’ the highest level (requiring the highest investment). These levels are similar to the Improvement Pyramid as a means of differentiating between levels of Lean implementation:

Figure 26: Typology of Lean elements – Philosophies, Policies and Practices

![Figure 26: Typology of Lean elements – Philosophies, Policies and Practices](source)

Cost savings from ‘Lean Practices’ alone (e.g. SOPs, Kanban, Takt-time) without accompanying ‘Policies’ or ‘Philosophies’ still amounted to an overall saving in yield of 8.6% (Figure 27). These translate as reasonable benefits given that they parallel or exceed typical profit margins for the sector. As Figure 27 indicates, the savings from Lean with all three elements considered (i.e. operating at the top of the Lean Improvement Pyramid, involving culture change) equates to 14.5% or an additional yield benefit of 5.9% when compared against the ‘Lean practice only’.

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\(^a\) Personal communication, March 2013

A practical example of such a low-cost approach was given by a café owner whilst being interviewed on Lean-like practices. Leaving his waffle machine on all day was a waste of energy and spoilt other foods in the kitchen, so he decided to make a small change to resolve the problem:

“The waffle machine we were using, we were leaving it on, it takes such a long time to heat up that we were leaving it on all day every day and obviously it’s just such a waste and it heats everything else up even more in the shop, so we only put that on all day at the weekends and in the week if people want a waffle then we use frozen waffles to be honest and nobody seems to mind that.”

Café/sweet shop, 6 employees, Birmingham

There were no measured results from this change, such as the cost of energy saved, but it would appear, to the owner at least, that the change was a worthwhile compromise between customer satisfaction and higher resource usage.

The ability to derive economic benefits from a low-cost, problem solving, Lean approach is important for the food industry to know. Many in the supply chain are far from this cultural transformation of the highest Lean level. They should not be dissuaded from embarking on the lower levels of the journey: there are still savings to be won and these have the potential to grow as the company evolves in its use of Lean over time.

Case studies show that very small businesses, such as the ten-strong Quick Food Products in the example below, can dramatically increase their profitability through initial Lean projects.

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**Figure 27: Savings offered by Lean thinking in the UK red meat supply chain**

![Graph showing potential savings across different stages of the production process](image)

Source: Adapted from Zokaei & Simons (2006)
Easy as pie

Founded 25 years ago, Quick Food Products Ltd is a family-run business based in Wolverhampton which makes Jamaican patties with beef, lamb, poultry, fish and vegetable fillings. Quick Foods has a large and loyal customer base, distributing its products directly to more than 400 fish and chip shops and convenience stores across England.

Convinced his business could grow, managing director Sean Young brought in the consultancy NPD Services to hone his manufacturing and distribution processes in 2009, with financial support from the Manufacturing Advisory Service. “We wanted to sharpen up our manufacturing control systems and free up capacity for new ranges,” says Sean.

The project team identified inconsistency in the way that filler was dropped from a hopper onto pastry sheets before the patties were formed. The factory staff had insufficient control over the weight of filler used in each patty; they were judging things ‘by eye’ and were erring on the side of over-filling.

While the ‘language of Lean’ was avoided, Lean-like tools were used including Standard Operating Procedures to reduce the variation in filling weights. MAS Specialist Advisor Maxine Chapman reports that a ‘Plan-Do-Check-Act’ cycle was also part of the problem-solving approach.

Quick Foods tightened up control over the speed of the belt carrying the pastry and the interval during which filler material is allowed to drop onto the pastry. More frequent checking of ingredient weights was also introduced. As a result, the variation in filling weight used in each pie was minimised. The improvement in process control has undoubtedly resulted in fewer process mistakes and therefore less food waste, although this has not been measured.

“When we started, the employees weren’t convinced that these adjustments would make much difference, and were worried the project might mean more work for them,” explains Maxine. “But with no additional staff, capital investment or raw material, the new way of doing things has enabled Quick Foods to produce an additional £2,500 worth of patties every week.”

With increased production and slicker distribution processes, the company now has the confidence to seek out new markets. “It’s a positive feedback loop,” says Maxine. Quick Foods believes the project paid for itself in weeks.

In summary:
- **Sub-Sector:** Food manufacturer
- **Company size:** Ten employees
- **Project:** Filler giveaway reduction
- **Tools:** PDCA, SOPs
- **Financial savings:** £2,500/week
- **Environmental savings:** Unquantified reduction in raw material and energy use per unit product.
- **Barriers:** Employee concern that the Lean project would make their job harder.
- **Success factors:** Staff has a pride in the quality of their product so wanted to improve things.
5.4.4 Common sense problem solving – the hidden Lean approach

The language of Lean can often lead companies to believe they are not implementing any Lean practices. Yet when asked about continuous improvement, or measures taken to ‘cut costs’, the company will often have several examples, many of which may actually involve the use of some Lean-like thinking. SMEs are particularly likely to cut costs and waste using common sense, rather than calling it Lean. One small retail owner, when asked if they employ Lean/CI techniques, commented:

“I think most of this, for people that are running their own business and have got enough common sense and intelligence to actually do that in the first place, it’s just, you know it, you don’t need really anybody telling you. You’re not going to have a business for very long ... because people aren’t going to come back to you if you’re not supplying good products, and you won’t make any money if you’re not doing everything else properly either.”

This use of terminology as a barrier to Lean is explored in greater depth in Section 6.3.3, but it is a good marker to position a company on the Lean Improvement Pyramid. A ‘common sense’ approach is based on reacting to a problem when it occurs. The sophistication of this reaction may range from a simple reorganisation of the store cupboard using clear labelling, or employing data analysis techniques to adjust processes on a production line. Either way, it is a solution-based approach to a problem.

Several SMEs interviewed for this study said that trying to control what raw materials they use was just ‘something they do’. They had an instinctive, if not measured, appreciation of which raw material costs were able to be reduced, and which they felt were simply unavoidable. For example, one food manufacturer had a series of pictures on the wall, showing what a standard end product should look like. This was a simple visual quality management system, and although far less formal than the SOPs found in larger organisations, was a common sense way of ensuring giveaway (or “waste”) did not escalate. Interestingly, energy and water costs were largely considered difficult to influence (not within the realm of common sense) and therefore did not attract much management attention. This was true for both SMEs and some larger organisations interviewed for this research.

This problem-solving approach is just as likely to be found at larger organisations, especially where practices such as Clean In Place are prevalent. The practice of CIP has long been in use in the food and drinks industry, and could be considered characteristic of a project-based problem-solving Lean approach. A case study published by WRAP, as part of the Drinks Roadmap, reports on improvements to CIP evidenced in the food and drinks industry in the following areas:

- process design
- optimising the CIP programme
- real time cleaning verification
- novel technologies
- low temperature detergents.

The approach is not necessarily always low cost, although it does lend itself to low investment opportunities. For instance, the Innovation Center for US Dairies is developing new low-temperature CIP systems requiring less energy and water, producing a less alkaline effluent. This change entailed significant investment given the scale of the operations involved. Resource efficiency savings from

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[a] Evidence from interviews carried in 16 SME businesses for this research, 2013
CIP may not always be appreciated yet can be significant. A Carbon Trust study showed that CIP and wash-down accounted for 13% of overall energy use in dairies\(^a\).

Examples are plentiful of this type of common sense approach in the food supply chain. Although it may not always target the biggest causes of waste, what is important is that it is recognised as a valuable method of taking the first steps to improving processes.

**5.4.5 Using technology to reduce waste**

Project-based problem-solving in the food industry very often centres on better or innovative use of technology. In this sense, Lean has evolved from its standard application in the automotive industry where it is production and process focused. Food companies often identify a problem by looking at the high waste figures. Any method of extending food shelf-life helps, for example, to keep waste lower.

An example of this is Raynor Foods, an Essex-based supplier of sandwiches, rolls, wraps and salads. It applied Lean techniques to the problem of the ‘soggy sandwich’ and also to reduce in-process of waste due to poor quality ingredients. The company was keen to extend the shelf-life of the sandwich but without resorting to modified atmosphere packaging which UK customers tend to reject, according to the company. Raynor recognised that the sogginess largely resulted from tomatoes and lettuce used in the products. The company developed its own hybridised lettuce called Verity Grace, which kept its colour for seven days, and a specially-bred tomato, called Intense, with tougher cell walls to retain moisture. The innovation cut tomato waste by 2% and halved the lettuce preparation waste\(^b\), along with other benefits as follows.

**For lettuce Verity Grace**
- Process yields increased by 12%.
- Preparation cost reduced by 50%.
- Eliminated white stalk and brown lettuce complaints.
- Lettuce waste reduced by 20%.
- Aesthetically superior and nutritionally superior to iceberg.

**For tomato Intense**
- Strong cell walls – does not seep liquid – so 95% reduction in soggy sandwich complaints.
- Tomato waste reduced by 20% and yield increased by 8% due to better shape.
- 1 in 4 standard tomatoes were wasted; with Intense it is only 1 in 16.
- Same price as standard, with a deep rich colour.

Other companies apply problem-solving via a technology approach to associated product issues, such as packaging and distribution. Although primarily a pharmacy-led health and beauty retailer, Boots UK also sells chilled foods. However, as the volumes of chilled foods are relatively small compared to non-chilled, it makes little sense to use dedicated refrigerated trucks just for this purpose. Therefore the retailer uses ‘thermotainers’. These boxes use chiller packs to maintain their contents at a low temperature, enabling food to be transported in standard trucks alongside core products. This distribution method allows the company to meet delivery windows for all products, for vehicle journeys to be optimised, and for vehicles to run fully loaded\(^c\).

\(^a\) Carbon Trust (2010) CTG033 Industrial Energy Efficiency Accelerator

\(^b\) Tom Hollands, Technical Manager Raynor Foods, (n.d), Create Your Future!, presentation supplied to Oakdene Hollins February 2013

\(^c\) Personal Communication, Alliance Boots, January 2013
A somewhat unexpected finding in the SME interviews undertaken was the use of innovative communication techniques employed by SMEs to allow better planning, and possibly reduce wasted food as a result. One SME is using Facebook to inform its customers of upcoming events, and another has developed a Smartphone app which allows customers to pre-order their food:

“We’ve just got ourselves an app. ... This is actually two weeks old and we haven’t actually, we’ve launched it, we’ve put it all on our leaflets and stuff you know, the barcode. ... So we’re slightly embracing modern technology, so it’s like being able to get orders at different times. Also the customers are coming in, they can pre-order on this so that we know what they actually want ready for their lunchtime. So if for example they want a Panini or baguette or something we’ll get orders coming in from 11.30am, 12 o’clock, we can get them ready so when they come in we can just pack it and go, and it all comes through on the internet.”

Restaurant, 20 employees, London

5.4.6 Starting with Lean – an SME approach

SMEs are particularly likely to find it hard to embark on Lean, given the general lack of resources available to small companies. One medium sized SME interviewed had recently planned new equipment purchases with efficiency in mind. The owner stated that she had found no advice available to help her with this and had to do it all herself. This example shows that a few more progressive SMEs are starting to consider efficiency savings when making purchases, or redesigning processes, but that they need some guidance to point them in the right direction.

Interestingly, the evidence from the interviews with SMEs for this research showed that Lean was more positively understood than ‘resource efficiency’. Some may not have been familiar with Lean terminology but immediately recognised it as something they thought they did, or aspired to do, when the principles were broadly explained to them. When asked about Lean in terms of customer value, SME interviewees were generally positive, even if their interpretation of customer value was not a Lean interpretation, with one stating ‘Value for the customer ... Yes, we do, that is something I’m doing definitely’. On the other hand, resources were understood as staff/time/money and not as waste/water/energy. When asked what first came to mind at the mention of resources, almost all SMEs interviewed talked about staff and money. They agreed that wasted materials, energy and water were a cost to the business, but could not generally elaborate on how they tackled such issues.

Table 10 below summarises the evidence from the interviews undertaken for this research on SMEs’ capabilities for Lean behaviours, and the extent to which these behaviours are currently implemented in order to promote Lean goals.

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*a Evidence from interviews undertaken with 16 SME organisations, 2013*
Table 10: SMEs Lean competencies (from interviews in 16 SMEs)

<table>
<thead>
<tr>
<th>Lean competency</th>
<th>Degree of SME capability</th>
<th>Geared towards Lean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness of business functions</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Integration of business functions</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Strategic planning</td>
<td>Low/medium (more evident in larger SMEs)</td>
<td>No</td>
</tr>
<tr>
<td>Setting goals and targets</td>
<td>Medium/high</td>
<td>No</td>
</tr>
<tr>
<td>Holistic decision-making</td>
<td>Low/medium (more feasible in smaller SMEs)</td>
<td>No</td>
</tr>
<tr>
<td>Efficient (lean-like) operating processes</td>
<td>Medium to high (but sometimes absent in small and young SMEs)</td>
<td>Some</td>
</tr>
<tr>
<td>Standard operating procedures</td>
<td>Low to high (significant variation between SMEs)</td>
<td>Some</td>
</tr>
<tr>
<td>Error-proofing</td>
<td>Low/medium</td>
<td>Some</td>
</tr>
<tr>
<td>Information flow between operations and strategic management</td>
<td>Low/medium (but generally unclear)</td>
<td>No</td>
</tr>
<tr>
<td>CI systems in place</td>
<td>Low/medium</td>
<td>No</td>
</tr>
<tr>
<td>Defined staff roles</td>
<td>Medium/high</td>
<td>No</td>
</tr>
<tr>
<td>Reviewing staff roles</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Staff empowerment</td>
<td>Medium</td>
<td>Some (but incidental)</td>
</tr>
<tr>
<td>Business performance monitoring</td>
<td>Medium</td>
<td>No</td>
</tr>
<tr>
<td>Operational process performance monitoring</td>
<td>Medium to high</td>
<td>Some</td>
</tr>
<tr>
<td>Making use of monitoring data</td>
<td>Low/medium</td>
<td>Some (rare)</td>
</tr>
<tr>
<td>‘Customer pull’ approach to production</td>
<td>Low (though evident in certain types of business)</td>
<td>No</td>
</tr>
<tr>
<td>Data sharing with customers</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Data sharing with suppliers</td>
<td>Low</td>
<td>No</td>
</tr>
</tbody>
</table>

Most businesses interviewed were in the service sector and so care must be taken in interpreting these findings. Less structured, individual communications also undertaken for this research found that manufacturers (not represented in the table above) were more likely to be aware of, and have competencies in, Lean-like approaches than foodservice and smaller retailers, for example. However, the evidence in Table 10 is useful in showing the generally low level of Lean-like activity present in SMEs, especially in the hospitality sector.

Some larger SMEs are taking steps to seek out help with process improvement initiatives. The case study below shows how Olives et al., small Dorset-based business, sought the help of the Manufacturing Advisory Service to help them take their first steps.
New process is worth its salt

**Olives et al** began trading 20 years ago and today employs 46 people. The Dorset-based firm brings in olives from overseas in bulk and adds value by water-curing them to remove some of the saltiness and then marinating the olives in herbs and spices. The finished product is re-packaged and supplied to retail, food service and export markets.

![Sorting and selling olives](image)

Ever keen to improve and streamline his process, company owner Steve Brown sought advice from the Food Innovation Service at Duchy College, with funding support provided by the South-West Manufacturing Advisory Service. The Lean consultants and Steve mapped the entire process in detail to identify resource efficiency opportunities which would make the most of existing equipment.

The team soon saw a way to improve the de-salination process. Previously, in each de-salination tank, just over half a tonne of olives was soaked in 300 litres of water for three days, the water being refreshed once during this period. But a few minor adaptations to each tanks now allows the water to be re-circulated, cutting the volume needed by about 60%. This is less than the 83% cut originally estimated during the Lean project planning, but still represents a substantial saving.

Steve admits that water was not previously being measured and only started to be considered an issue when it made itself known on the company balance sheets. “We tend only to notice things when they start to stick their heads above the parapets,” he says, although he insists that cost saving was not the primary driver. Nor were the anticipated environmental savings. “Our goal is always just to do things better, to save time, effort and stress,” says Steve.

In summary:

**Sub-Sector:** Food processor  
**Company size:** 46 employees  
**Project:** To improve the efficiency of olives de-salination  
**Tools:** Value Stream Mapping  
**Outcomes:** Process speeded up and water use cut  
**Financial savings:** Not reported  
**Environmental savings:** 60% cut in water use  
**Success factors:** Senior management commitment to change; financial support from MAS and technical support from Food Innovations Centre  
**Barriers:** Not reported

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Industry interview with Manufacturing Advisory Service and Olives et al., March 2013
5.4.7 Lean tools commonly used at the project-based level

Companies implementing Lean at this lower level tend to jump quickly into the details of the problem. The research found little use of planning tools such as VSM, or Six Sigma DMAIC. Kaizen blitzes are used – although maybe not branded as so – together with simple common sense fixes. The Lean Improvement Pyramid would show the activity of companies at this level as follows (Figure 28):

**Figure 28: Tools used in project-based problem solving**

- Lean Culture
- Systemised problem-solving
- Project-based problem-solving

- Kaizen – one off project blitz
- Production meetings to identify engineering fixes
- Driven by single ‘expert’ or consultant

5.4.8 Associated resource efficiency benefits

It is not possible, given the lack of available data, to quantify the resource efficiency savings associated with Lean projects at this level. However, given the profile of companies often operating at this level, certain assumptions can be made. Many of the organisations will be small or less established businesses that do not have a recycling/zero waste policy in force. Therefore simple projects that reduce waste will automatically reduce the amount of waste that would have been sent to landfill. Small, yet useful, savings in energy and water may fall out of isolated projects to streamline production processes.
5.4.9 Summary

Figure 30: Summary of project based problem-solving with evidence from industry

Source: Oakdene Hollins
5.5 **Systemised Problem-solving**

At the stage of *systemised problem-solving*, a company recognises that problem-solving is an ongoing challenge and generally establishes in-house continuous improvement managers or teams to address resource efficiency challenges. Lean principles and practices are embedded in the organisation and consideration is given to supply chains as well as to internal processes. Companies begin to recognise the importance of correctly identifying issues which carry the greatest cost saving opportunities. The use of KPIs, SOPs and VSM is a hallmark of this stage, while more complex Lean tools such as Six Sigma may be appropriate for larger firms that may also use their influence to change the behaviour of both suppliers and customers.

A systemised problem-solving approach may be driven by a Lean consultancy, a Lean champion or team, or by a motivated managing director. Training is a key feature, with staff empowered to identify and solve problems themselves. In addition, Lean thinking might be extended beyond production to other business functions including IT, administration, order-processing and finance.

5.6 **Systemised Problem-solving in practice**

5.6.1 Coverage

Systemised Problem-solving is well evidenced in the food industry, most commonly recognised by the use of KPIs and VSM. Larger organisations may also use Six Sigma and the associated DMAIC approach. For improvements to be sustained, some form of employee and senior management buy-in is required. Commercial or even environmental KPIs may be in use. For example, where waste rates are cut during a project, the KPIs are adjusted to reflect the new rate to avoid reverting to the previous level. Crucially, at this level of the Lean Improvement Pyramid, businesses begin looking beyond their own operations, working to improve the resource efficiency of the entire supply chain. More time is spent in the identification and planning stages than is evident in the bottom tier companies.

5.6.2 Key performance indicators and standard operating procedures

The implementation of commercial and/or environmental KPIs demonstrates a more systemised approach to problem solving. For example, the retailer Marks & Spencer (M&S) tracks food supplier performance on 'balanced scorecards’ covering five aspects: Technical, Commercial, Logistics and Product development and sustainability performance. M&S is now working to align the KPIs across the supply chain, recognising that suppliers treated in isolation can only achieve so much. There is a
need to integrate operations along the supply chain and to align the KPIs. The current drive is to use VSM to identify what emphasis should be whereb.

5.6.3 Identifying the problems using value stream mapping (VSM)

VSM (value stream mapping) is described by IGD as “hugely powerful” when it was adopted for end-to-end agri-supply chainsb. As discussed in Section 3, VSM helps visualise the supply chain, identifying strengths and weaknesses. If correctly used, the tool will reveal the quick-win/low-cost and the high benefit/low-cost opportunities. The flow of information is as important as physical flow of product.

M&S encourages its suppliers to use VSM to identify where in the supply chain action should be focused. Aiming to manage its supply chain in the manner of the automotive sector, the retailer facilitates feedback of capacity and planning data so as to prevent the waste associated with demand amplification. One example of this concerns the waste associated with sandwiches. Funded by WRAP and guided by IGDc, M&S worked with its supplier Uniq to address waste levels which were then exceeding 5%. The short shelf-life and unpredictable demand for the product only exacerbated the problem. Daily processes, order levels, raw material usage and replenishment techniques were studied and changes recommended. A review of the range of sandwiches led to fewer manufacturing changeovers for Uniq and lower stock write-offs for M&S. In total, food waste was cut by 129 tonnes in 2010, and a further 170 tonnes savings were anticipated in the following year.

As part of the same WRAP-funded work programmec, the retailer Musgrave worked with United Biscuits to identify waste reduction opportunities through mind-mapping, scoping and prioritisation; end-to-end supply chain ‘walk-through’; KPI information gathering; and process mapping. As a result of these Lean techniques some 36.4 tonnes of supply chain waste were prevented in 2010.

In the wine industry, VSM was used to try and reduce production lead time at Rioja producers in Spain. It successfully reduced lead-time from 440 days to 162 days, yet a secondary benefit was the reduction of raw materials by 13%. This led to an economic savings of €49,500 per year along with the stacked environmental savings of using less raw materiald. This example shows how powerful VSM can be in tackling waste which may not even have been anticipated at the start of the exercise.

The following case study is an example of a food manufacturing company using Lean in a systemised way to cut the serious problem of product giveaway.

Lean tips the scales: How process mapping aids cut product giveaway

A multi-site producer of processed food products, turning over £150 million per year, is leading best practice in the UK food industry. Positioning itself at the middle to upper section of the Lean Pyramid, the manufacturer is dedicated to Lean efficiency improvements, applying the principles across all areas of its business – Production, IT, Order Processing, Human Resources, Accounts, etc. While change has been driven by the company’s Lean Director and the Continuous Improvement Co-ordinator, the successful adoption of Lean principles is enabled largely by the commitment and vision of the Managing Director.

‘Big picture mapping’ is used initially, to understand the processes across all operations. VSM then drills down to the detail (‘deep dives’). This then sets priorities for either ‘quick-fixes’, or significant projects.

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b M&S, personal communication, August 2011 Peter Whitehead, (formerly Agri-business Programme Leader, IGD); August 2011

c IGD (2013), Supply chain waste prevention guide 2013 – from factory in-gate to till

d E. Jiménez et al. (2011) Applicability of lean production with VSM to the Rioja wine sector
As a result of this mapping, opportunities soon ‘fell out’, including the key project to tackle product giveaway. Final product weights were being quality controlled to meet minimum legal requirements for underweight, but this was driving giveaway up. No KPI was in place to measure giveaway. The CI team and production operatives saw an opportunity to reduce wastes and costs by improving the way products were weighed and substituted. The company already knew that each 0.1% of giveaway equated to a loss of some £52,000. Product giveaway was generally around 6% to 12% (average 7.5%) and was certainly alarming.

Six Sigma tools were used to collect and analyse performance data, which led to an assessment of the methods by which products were weighed. Through the use of problem solving techniques (e.g. Process Capability Index, Histogram, Run charts before and after the trial, Fishbone Diagrams, Variable Control Plan, 5 Whys, etc.) the scales were found to be unstable, making target weights difficult to achieve when an operative was under pressure to achieve volume. The problem was exacerbated by the business’ drive to avoid underweights. Consequently, operatives had erred on the side of caution and were overfilling packs to avoid falling foul of minimum product weight regulations.

Critical-to-Quality Characteristics (CTQs) of the packaged product included final package weight, product expiry and labelling. If one or more of these was not correct, expensive product holds, repackaging or product giveaway could result. New, more appropriate and reliable scales, supported by a more robust weighing procedure, reduced giveaway (and hence costs) while continuing to ensure that products would not fail on underweight issues due to non-conformance. These changes were supported by new SOPs to replace the old methods, giving a standardised process which was capable of being audited.

Since the scales rationalisation phase, the CI team has continued to attack the problem of giveaway, now down at 5.5%, by improving raw material substitution.

Since introducing Lean six years ago the company has saved £10 million and continues to undertake more Lean projects, driven by either strategic direction, or emerging issues. Although the environmental benefits of this work have not been recorded, they are likely to be substantial and take the form of reduced material use, and associated reductions in embedded energy, water and carbon.

In summary:
- **Sub-Sector**: Manufacturing
- **Company size**: 450 employees
- **Project**: Giveaway reduction
- **Tools**: VSM, Six Sigma, Visual Management, Standard Operations, Cost-Benefit analysis, 5 Whys, Pareto Analysis, Fishbone Diagram, and other Lean tools
- **Outcomes**: Product giveaway reduced to 5.5%, with further improvements expected.
- **Financial savings**: At least £1 million per year
- **Environmental savings**: Unspecified
- **Success factors**: In house expertise, top-level buy-in
- **Barriers**: Resistance to change
5.6.4 Six Sigma to drive resource efficiency

The sandwich manufacturer Raynor Foods, referenced in Section 5.4.5, used the statistical control methods of Six Sigma to reduce giveaway of butter in its products. Previously, a roller butter machine was used; this produced high levels of waste, had a limited capacity and so needed changing often, was generally unreliable and inaccurate, and required a long clean down process. As a result of this problem identification, the company designed a butter spray machine. With giveaway dropping from 3% to 1.7%, the savings in raw material costs offset the capital investment in the machine. Additional benefits included savings in energy and water use from less frequent/lengthy cleaning. Although cost was the first driver of change, the resource efficiency savings were a welcome added benefit. A conclusion on a presentation given by the company sums it up well:

“You can achieve sustainability through innovation: You can be innovative to save money, and as a by-product achieve sustainable solutions … whilst [enhancing] quality and food safety …”

5.6.5 Rolling out a Lean programme: dedicating resources and initiating training

Larger companies are able to accelerate progress up the levels of the Pyramid by having the resources to dedicate to a Lean programme. Kellogg’s K-Lean programme started across the worldwide group towards the end of 2008 and the start of 2009. At this stage Lean practices were pilots, indication that Kellogg’s was then sitting in the middle tier of the pyramid. Given the level of commitment and resources dedicated to the roll-out, it may well now have reached the higher levels of Lean implementation.

Kellogg’s brought in external consultants to implement 40 week pilot programmes where Lean tools would be implemented in different areas of factories while ‘internal capability’ was built through training and coaching.

The main objectives were:

- to build and create capacity – delivering more output in less time (i.e. being more efficient, including energy use efficiency)
- to reduce waste – saving on costs and materials (‘waste’ defined as both ‘materials waste’ and ‘non-value adding activities’ [i.e. the Lean definition of waste]).

The main tools used were 5s, TPM and SMED.

Kellogg’s has now started disseminating Lean thinking to its upstream supply chain through its ‘Lean to Supply’ programme. Some of its suppliers are now using the Lean tools: one of the areas where Lean is particularly being applied is the inbound transportation link for main ingredients.

As a result of K-Lean in the last three years, Kellogg’s has seen a 30% reduction in materials waste and a 5% increase in overall capacity. To put that in perspective, the savings realised would be sufficient to build a “small factory”. Kellogg’s has also reduced energy use by 5-6% without having to invest any capitalb.

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b Richard Burkinshaw & Albert Roch, Kellogg’s, Personal communication, October 2011
5.6.6 Lean tools commonly used at the systemised level

At the systemised-problem solving level, more Lean tools are being used for process improvements. There is a greater degree of knowledge about such tools, and an understanding of the benefits their use will bring over simple ‘common sense just-do-it’ approach of the lower level.

Figure 31: Lean tools commonly used for systemised problem-solving

- Kaizen – pre-planned event
- SOPs and KPIs introduced
- VSM – mapping a process
- 6σ DMAIC – used for a project
- Driven by Lean or CI Teams

5.6.7 Associated resource efficiency benefits

The shift from isolated projects to a Lean programme that is rolled out across a company means that associated resource efficiency benefits are also more significant. Paper-based systems are replaced by more sophisticated and integrated IT systems, reducing paper usage. Projects are extended to other areas of the organisation, resulting in more significant waste savings. KPIs embed these savings so that progress is maintained. Stock management and packaging/distribution are examined for waste, cutting space, and therefore energy required for heating/cooling/lighting.
5.6.8 Summary

Figure 33: Elements from systemised problem solving using examples from industry

Source: Oakdene Hollins
5.7 **Lean Culture**

At the pinnacle of the Lean Pyramid sit organisations which have adopted a fully *Lean Culture* from top to bottom. The philosophy of Lean is second nature, with all functions continually examined and optimised for the value they add. Once properly identified anywhere in the supply chain, waste is minimised or eliminated using a variety of established or bespoke Lean tools. Attaining this level takes time and requires the culture of Lean thinking and continuous improvement to be embedded throughout the organisation, as well as similar transformations in first and even second tier suppliers. The top level does not mark the end of the Lean journey: efforts to improve resource efficiency are continuous.

***‘Changing the culture’***

The common belief is that to be ‘fully’ Lean requires changing the culture of the whole organisation. Indeed whilst there is some technical skill in implementing Lean tools, the overarching success factors of Lean practices are behavioural and cultural. What is meant by this is that improvement requires change, and change rests on behavioural factors even more than technical ones. Without a person’s willingness to fully embrace a change of working practice, that process will not improve, regardless of the technological or analytical breakthrough that has been made using Lean tools. It is at this stage that change management, and all the associated principles of educating, training, and empowering employees, becomes important.

At level 2 of the Pyramid, the requirement was for a change in the mind-set of individuals involved in Lean. At this level, the demand is that the collective culture must change, that a company culture must develop.

In the food industry, the measure of Lean culture change has evolved into a type of ‘forward-thinking mentality’, characterised by:

- an openness to change and willingness to look beyond the *status quo*;
- passionate leaders who can motivate the entire workforce into embracing Lean;
- clear and transparent standard procedures that all employees support; and
- a belief that measuring and monitoring is as important as the work procedure itself.

Whilst the automotive industry embraced the pure Japanese Lean terminology of ‘Lean philosophy’ and ‘culture transformation’, the food industry has discarded the elements that are less relevant and is establishing its own language of continuous improvement. However, as the real world examples below show, attaining this level of transformation is not easy, and this is a goal that few in the food supply chain have yet reached.
A Lean supply chain
At the top level of Lean is the recognition that it is no longer companies competing against each other, but whole supply chains. Goldratt’s Theory of Constraints makes this explicit; a supply chain is a series of interdependent processes, whose performance is limited by its weakest link. This weak link is the system’s ‘constraint’. Organisations that have transformed themselves into a Lean, continually improving entity are looking towards their supply chain partners to do the same.

Whether consciously aware of this Theory of Constraints or not, those at the top of the food supply chain – most often the retailers – are doing just that. They seek to use their influence to bring their second and third tier suppliers up to the highest level they can, in order to better facilitate a flow of goods that wastes neither product nor resources. Examples of how retailers are doing this are discussed below.

5.8 Lean Culture in practice

5.8.1 Coverage

This report found few companies in the food and drink industry that have completely embraced the mind-set of continuous improvement and that are currently using Lean as standard procedure with the full involvement of suppliers. Those that have appear to be the largest organisations that have the available time and resources. Despite this, there is a definite sense that the food industry is quick to see the value in ‘Leaning’ the supply chain, and that this is an industry that is willing and ready to move towards this high level of efficiency.

5.8.2 A Lean supply chain

As documented above, there is very much a focus on Lean supply chains at this level. Given the fast-moving, perishable nature of food and drink in the supply chain, the industry easily appreciates the need to move goods quickly and efficiently along the chain, incurring as little waste as possible on the way.

McDonald’s is a good example of a multinational foodservice organisation taking measured and practical steps in the foodservice sector to increase the competitiveness of its supply chain. Interestingly, McDonald’s supply chain initiative is explicitly environmental. Its European supply chain team has operated an environmental scorecard across the European region for about 10 years. Every year, all the major suppliers to McDonald’s feed into this scorecard their performance in terms of environmental management systems, energy use, water use and waste. The results are collated and the suppliers are ranked. In 2011, McDonald’s introduced a new scoring system to make it easier for the suppliers to see where they have improved and where the greatest opportunities for improvement lie. Suppliers can benchmark how they are doing in relation to their competitors (e.g. potato suppliers like McCains can see how they are doing versus a competitor such as Lamb Weston in the Netherlands). Importantly, the scorecard approach enables suppliers to share best practice.

In 2007, McDonald’s introduced a continuous improvement programme called ‘Darwin – The Evolution of the Supply Chain’ which has led to savings of £9.5 million (equivalent to 15% of the cost base) across all the logistics operations, despite the distribution volume increasing by 25% over the same period.

Carbon emissions have been reduced by 40% through:
• the switching to biodiesel (which has also saved money by insulating them from the rising price of oil)
• the use of telematics systems for improving miles per gallon.
Some of the other actions taken to achieve the 15% cost reduction include:

- optimisation of delivery schedules across the complex transport schedules (1,200 stores and three distribution centres)
- transport planning and ordering to ensure the maximum number of cases per journey (through ‘The Attack on Fresh Air’)
- case size optimisation
- cutting out journeys by backhauling cardboard packaging, used cooking oil and grease trough waste (which is used to fuel the biodiesel production plant).

McDonald’s is just one example of sharing knowledge, ideas and information within the supply chain. The emphasis on environmental elements as well as cost reduction is important and is one of the first times that Lean and RE have been linked in this way. This suggests that at the top end, RE in the food industry is moving towards the supply chain function.

5.8.3 Identifying the wider opportunities

Those at the middle level of the pyramid often use Lean methods to identify problems in a specific area, such as on a production line. At this top level, VSM and DMAIC are used in their widest sense, working back from a single product flow through to the fundamental way in which product is moved around the country. This allows the most significant – and likely most difficult – problem areas to be identified.

The UK retailer Tesco is a good example of this level of planning. Tesco was among the first to embed Lean into the fabric of its operations. Terry Leahy, the former chief executive, cited Lean as one of the top ten reasons for the company’s success*. Realising that its customers wanted different shopping formats depending on their needs, Tesco used Lean to develop an efficient distribution chain allowing customers to buy the same items in different store formats for the same price.

Tesco’s rapid replenishment system, using the same suppliers, cross-docking centres and multi-drop vehicles, is designed to reflect ‘customer pull’ without increasing costs. The tool used to set this in motion was the mapping of supply of a can of Coke from manufacture to point of sale; this was just the start of a larger drive to implement Lean throughout Tesco and its supply chain. VSM exposed problems, allowing Tesco to redesign the way it interacted with suppliers b, and the way it continues to do so.

5.8.4 Linking Lean and the environment

Businesses operating at this top level recognise the interaction of Lean and resource efficiency. In many respects they are putting into practice the theory of the US EPA, which promotes the benefits Lean can bring to environmental objectives.

Within M&S, the motivation for action arose initially from a CSR imperative – to be seen to be improving wages and living standards in the off-shore suppliers, notably in textiles. Environmental issues became the second concern, addressed by another set of protocols. However, it became clear that a holistic approach was necessary to join economic, social and environmental outcomes. Rather than simply throwing money at the problem, Lean could provide a framework for eliminating lost value, setting targets and KPIs for suppliers that matched the needs of M&S as a customer. These three components combine within M&S’s Sustainability Framework:

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*a Cited in: Deloitte (2010), Lean and Fit, Improving frontline service in an age of austerity
*b Womack, J & Jones, D (2005) Lean Solutions
5.8.5 Environmental management and CSR as drivers for Lean

At this top level, the environmental management and CSR reporting of big organisations increasingly requires a display of tangible resource efficiency results. Whilst Lean approaches are still driven by commercial competitive advantage, the rising prominence of resource efficiency reporting encourages businesses to also consider the benefits that Lean approaches may bring environmentally.

The brewer SABMiller has used Lean for the last 20-25 years but in the last 5-7 years the sustainability focus has been drawn in. Ed Koch, Head of Manufacturing Development, says that Lean and green are now ‘joined up’ in both our strategy and approach. Although there is much in-house Lean expertise, SABMiller has recently turned to engineering consultants to help quantify the way Lean brings about water and energy savings. This research was used to build a customised, actionable plan to reduce water and energy usage. The results are presented in the company’s CSR profile:

“Operational excellence [i.e. Lean] is the hallmark of everything we do. By focusing time and resources to develop new solutions to meet our target we are making good progress. This year SABMiller produced more beer using less water, using 706 million hectolitres of water in lager production processes, a reduction on last year. Our average water consumption per hectolitre of lager produced fell to 4.0 hl/hl, 5% less than the previous year. Since 2008 when we first set our target of reducing consumption per hectolitre of lager by 25% by 2015, our water efficiency has improved by 13%.”

5.8.6 A cultural transformation

The willingness to change and improve continuously, displayed at every level of an organisation and throughout every department is indicative of a Lean culture transformation. All the industry examples above are testament to this, for without this behavioural approach none of the Lean processes implemented would have been as successful.

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5.8.7 Lean tools commonly used at the Lean culture level

*Figure 35: Lean tools commonly used at Lean Culture level*

- VSM – across departments & supply chains
- 6σ DMAIC and other sophisticated Lean tools – used for supply chain

5.8.8 Associated resource efficiency benefits

Resource efficiency benefits are most likely to be measured at this level, although whether they have resulted from a Lean intervention, or from another approach, sometimes remains unclear. Certainly large scale savings are possible when Lean is used across an entire supply chain. As the examples show, companies like McDonald’s and SABMiller have made significant energy and water savings. The use of standard procedures and KPIs anchor improvements and prevent learnings being lost when employees move on, and supplier scorecards drive the supply chain to greater environmental efficiency.
5.9 Summary

Figure 37: Elements of a Lean culture from industry examples

Source: Oakdene Hollins
6 Barriers to Lean in the food industry

This section details some barriers for food and drink companies looking to implement Lean and is summarised visually in Figure 38.

Figure 38: Potential barriers to Lean in the food and drink sector

Figure 38: Potential barriers to Lean in the food and drink sector

Source: Oakdene Hollins

Whilst Section 6 shows that Lean activity is present in the food and drink supply chain, the fact that most companies remain towards the lower sections of the Lean Pyramid (see Appendix 1) suggests that there is still much potential for further improvement using Lean. Some features of the food and drink supply chain positively encourage Lean (see drivers in Section 4.7). Other features act as barriers to its implementation and are areas where support may be needed within the industry. The barriers show where progress still needs to be made in preparing the industry to take Lean forward, as well as deciding how to ‘sell’ Lean to the food industry through policy intervention or promotional material. The major barriers are:

- lack of resources – time, money, training, perceived and actual complexity of Lean
- perceived requirement to change ‘the culture’
- lack of motivation and commitment
- low skill level and unfamiliarity with English language
- rapid turnover of product ranges
- seasonal availability of products
- natural product variation
- high level regulation and food safety
- people-orientated, rather than automated
- large number of SMEs in the supply chain.

6.1 Lack of resources

A lack of resources, training and management commitment are cited as the biggest barriers to Lean implementation in any business sector according to a 2005 report (Table 11).
Table 11: Obstacles to implementing Lean

<table>
<thead>
<tr>
<th>Obstacle</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of resources</td>
<td>27%</td>
</tr>
<tr>
<td>Lack of training</td>
<td>26%</td>
</tr>
<tr>
<td>Top management commitment</td>
<td>21%</td>
</tr>
<tr>
<td>Involvement in other activities (Six Sigma, TQM)</td>
<td>11%</td>
</tr>
<tr>
<td>Hard to apply in my industry</td>
<td>9%</td>
</tr>
<tr>
<td>No clear benefits of Lean</td>
<td>6%</td>
</tr>
</tbody>
</table>

Source: Oracle

Even the smallest improvement project requires time and money. As in other sectors (Table 11), a lack of resources was perceived as a barrier in the food industry. Capital is often required in the form of costs sunk into existing processes or tools, or investment capital for re-engineering production processes.

According to one Lean expert, food businesses “will always do the quick and easy (low cost) things first but they could be getting down to 1% waste with much tighter process control and usually with some investment. Whether or not a food company will invest will depend on the market they are in.”

For SMEs, the fees levied by external advisers for achieving Lean serve only to accentuate the barriers; see, for example, Table 12 which presents costs quoted by Enterprise Ireland for implementing different levels of Lean.

Table 12: Scope and scale of Lean implementation at various levels

<table>
<thead>
<tr>
<th>Project summary</th>
<th>Key outcomes</th>
<th>Duration</th>
<th>Project cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean: Start</td>
<td>Short, cost-reduction project delivered by external Lean provider. Introduction of basic Lean principles and techniques.</td>
<td>Cost reduction targets achieved.</td>
<td>Typically 8-12 weeks</td>
</tr>
<tr>
<td>Lean: Plus</td>
<td>Medium-scale business improvement project(s) delivered by external Lean provider. Significant learning and use by company of Lean techniques, and/or other proven business process improvement methodology which can deliver cost reduction</td>
<td>Significant productivity improvement targets achieved; Embedding of business improvement culture and lean techniques; Cohort of trained staff; Programme to pursue company-wide improvement.</td>
<td>Typically 30 day assignment days over 6-9 month period</td>
</tr>
<tr>
<td>Lean: Transform</td>
<td>Holistic company transformation programme by external consultancy team.</td>
<td>Company-wide transformation in culture and performance; Business improvement and productivity targets achieved; Sustainable continuous improvement programme established across the business and its supply chain.</td>
<td>1-2 year project duration</td>
</tr>
</tbody>
</table>

Source: Enterprise Ireland

Oracle (2005) Understanding the Lean Supply Chain: Beginning the Journey
Personal communication, August 2011
The lack of training referred to in Table 11 may stem from the perceived complexity of implementing Lean. The large amount of published literature and existence of specialised Lean consultants can lead to the perception that Lean is ‘difficult’. Whilst some external assistance may be helpful at certain points, or at the highest levels of Lean, examples in this report show that success can still result from a common sense, in-house approach to Lean.

6.2 Perceived culture transformation

Given that Lean is invariably imposed as a top-down initiative, significant cultural barriers may need overcoming in order to embed Lean in an organisation. As with training, the perceived need for transforming organisational culture change may also be a block. In a survey undertaken by Aberdeen Group, 91% of consumer product manufacturers saw the “significant culture change required” as the greatest challenge to implementing Lean⁶. Many individuals within companies resist change for a variety of reasons, such as:

- a fear of losing employment/jobs
- feeling threatened by the process of change/knowledge sharing - wanting to feel indispensable
- resistance from employees
- a lack of understanding about why change is to take place
- a lack of communication or trust
- employees fearing the unknown

The training and expertise needed to effect this ‘management of change’ appears unattainable to many organisations.

6.3 Lack of motivation

One external industry practitioner reports that managing directors of smaller food companies often describe themselves as ‘artisans’ rather than manufacturers, while managers working in production lines come from a food safety or food quality background – but not a process engineering background⁷. Some argue that, as a result, the food industry is more accepting of levels of waste (e.g. more than 5%) which would be intolerable in other sectors⁸. Even where senior management is motivated, inertia or even resistance may be encountered at lower levels of an organisation, especially if employees are not involved in decision-making. In fact, the term ‘Lean’ has been interpreted by some as a cut in hours or even employment – neither of which is a necessary outcome of Lean thinking.

Motivational barriers may be at their most intractable where staff are on short-term or seasonal contracts - common in the food industry - and thus have even less buy-in to improvement projects. Silo structures – people and departments working in isolation from one another, and failing to share information – are found in any large organisation and block involvement and co-operation in Lean improvement projects. Evidence suggests that silos exist in the food industry. For instance, M&S reported early difficulties in disseminating Lean practices because suppliers’ control charts were “the domain of the supervisor, not the responsible operator”⁹.

In larger organisations, the issue may be one of segregated departmental responsibilities with competing KPIs. Above a certain size of company, responsibility for Lean management and environmental

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⁸ Personal communication, August 2011
⁹ Personal communication, August 2011
¹⁰ Louise Nicholls, Head of Responsible Sourcing, M&S; October 2011
management exist in a ‘parallel universe’. As the WRAP waste prevention site reviews found\(^a\), Lean tends to come under operations management and the environment under Health, Safety and Environment (HSE). This makes it more difficult, if not impossible, to encourage the linking of Lean and sustainability.

### 6.4 Skills and language

A shortage of appropriate skills and training in Lean, both of which stem in part from a lack of resources and top-down commitment, are also barriers. The problem is worsened by the fact that a large proportion of the workforce in the UK food and drink sector is unskilled, and for many employees English is not a first language. The UK Skills Council Improve states that only 19\(^b\) of workers in food manufacturing and processing hold a qualification at level 4 or above, compared to 35% across all industries\(^c\). 22% of the workers are non-UK nationals, with two-thirds from non-English speaking Accession 8 countries (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia or Slovenia). Whilst this profile may bring strength to the industry in some areas, it does present problems in communicating more strategic or long-term transfer of knowledge.

A recent history of consolidation across the food industry may also be aggravating the problem. With factories or depots merging, employees with different cultures and working practices may come together, challenging the roll-out of Lean initiatives across teams or lines. A workforce which has already been subject to uncertainties and change may prefer to stay in more comfortable territory, rather than take risks with new working practices and projects.

The language of Lean itself can be a barrier for some. When one large retailer was given a Lean methodology by an external consultancy, the Japanese terminology was initially seen as alienating and impenetrable and needed translation into a ‘local vernacular’. Lean was also perceived as too complex\(^d\). For the same reason, Envirowise – a former government-funded agency offering environmental advice - avoided Lean terminology\(^e\).

However, visual aids that transcend language go some way to addressing these barriers, and Lean’s focus on the visual workplace and standardised work practice is relevant in this respect. In addition, it may be worth modifying the language so it is more appropriate to the audience, be that operational managers or environmental managers, as has been recommended by the US EPA (see Section 4.4.2).

### 6.5 Rapid turn-over of product ranges

Retailers seek to keep consumers interested by frequently changing the look and nature of products. This provides challenges for suppliers, as it results in uncertain demand patterns and leads to difficulties in planning standardised production processes – a goal of Lean.

One manufacturer of ready-meals, reports that every 6-9 months the product will change to a greater or lesser extent from a new recipe to a complete redesign of product packaging, which leads to a level of reactivity in the business. Companies may not have the luxury or stability of being able to apply forward-thinking continuous improvement\(^f\). Knee-jerk problem solving, of the type found at the base level of the Lean Improvement Pyramid, will only be applied once a problem is obvious, by which time the product range is about to change again.

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\(^a\) WRAP (2012) Waste Prevention Summary Report
\(^b\) Workers in food and drink manufacturing and processing, England, 2011
\(^c\) LIEP (2011) The Food and Drink Manufacturing & Processing Industry: Prosperity for All
\(^d\) Personal communication, October 2011
\(^e\) Personal communication, August 2011
\(^f\) Personal communication, August 2011
However, the cereal manufacturer Kellogg’s combines Lean thinking with a management approach termed ‘Agile’ which caters for the ever increasing complexity of SKUs and gives an ability to change to an evolving portfolio. Using Lean techniques to identify opportunities for waste minimisation right at the start of a process means that maximum benefits and savings will be gained.

6.6 Seasonal availability

While Lean seeks to minimise inventory, storage is an inevitable part of food production in order to respond to seasonal availability of raw materials.

There are two current solutions to this problem. With less perishable foods, or where techniques to extend shelf-life (e.g. freezing, modified atmosphere packaging, preservatives, etc.), are acceptable to consumers, then bulk storage is an option. For instance, British garden peas are harvested, packaged and frozen during just one or two weeks, and then are supplied frozen for the rest of the year. However, this would violate Lean principles and may result in significant energy use through the refrigeration. The other strategy is to procure products in smaller quantities and at more regular intervals but from overseas suppliers. While this approach appears more aligned with Lean principles, the environmental impacts associated with transport – and the economic costs – may also be significant. For many products this may be the only choice beyond not offering the ‘out-of-season’ food in the first place.

6.7 Variability of raw materials

Whether the belief is valid or not, some food and drinks companies perceive the non-uniform nature of raw materials as a barrier to Lean: no two apples, wheat grains or joints of pork are identical in physical or chemical composition.

Some smaller food manufacturers express the view that they cannot perform as efficiently as other sectors, including automotive, because their raw materials are natural and variable. Given that retailers perceive that consumers expect standardised product, the supply chain is under pressure to reject ‘out-of-spec’ ingredients and products, resulting in negative financial and environmental impacts such as grading waste. The variability of materials presents significant challenges during manufacturing processes and may, for instance, result in giveaway. The factory manager at frozen ready-meals manufacturer apetito reports difficulty in implementing “all the tools used by Toyota because of the variability of raw materials”. In general, the industry solution has been to adapt Lean tools to take account of this difference in production processes. It may be that there is an unfounded belief that Lean will not work due to material variability, and that what is needed is guidance on how to overcome the issue.

6.8 Regulation and food safety

Food safety and traceability, animal welfare, nutrition and obesity, environmental sustainability and other issues are relentlessly scrutinised by the media, policy makers, and consumers – as well as by actors elsewhere in the supply chain. Many of these areas are subject to regulations and standards, and businesses employ managers to ensure compliance with the rules. Food hygiene and provenance, in particular, carries enormous importance; breaking these rules risks losing all the trust of its retailer/client and consumer. Complying with food safety regulations may override, and sometimes conflict with, other goals including improvements in resource efficiency. A retailer interviewed for this project reports that safety of products ‘trumps’ all other considerations, and offers the example of packaging. The priority is

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a Richard Burkinshaw, European Environmental Strategy Manager & Albert Roch, Kellogg Company, October 2011
b Chris Sturman, Chief Executive, Food Storage & Distribution Federation, August 2011
c Personal communication with food manufacturer, August 2012
d Personal communication, apetito, November 2011
to protect the product from microbial contamination even if this means more material has to be used, including possible non-recyclable materials. However, product safety is important in other sectors - not least in automotive manufacture - and an opportunity may, in fact, exist to incorporate Lean into food safety programmes.

6.9 People versus automation

For Lean to be fully embedded, a continuous improvement culture must evolve from the top to the bottom of an organisation. Employee motivation and understanding is crucial. Often a change is needed in the way employees think, work and interact with one another. This can be disruptive, particularly in the short term; when consumer product manufacturers were surveyed, 91% reported the “significant culture change required” as the greatest challenge to Lean.

Certain features of the food and drink sector can make change harder still. It may be no coincidence that Lean originated and flourished in industries which are traditionally less dependent upon human input: while the manufacture of cars or electronic appliances is largely automated, the food and drink supply chain relies heavily upon manual labour. People need to be convinced of the need to change and this is where behavioural elements, and management of change, become critical.

6.10 SMEs

SMEs make up a significant proportion of food and drink organisations and, collectively, can contribute much to improving the efficiency of the industry. However, they can act as a barrier to progress due to difficulties communicating Lean principles to them. There are a number of common misconceptions that would need to be overcome when engaging SMEs with Lean practices, namely:

- The often limited depth of understanding of Lean or CI. However, once explained, Lean resonates more than the concept of resource efficiency, due to its focus on improved competitiveness.
- The view that Lean is common sense and that ‘all small businesses do it’.
- The belief that the time or finances required to do more on Lean outweigh the potential benefits; if solving a problem requires more resources than it saves, then it can legitimately not be considered a problem.

6.11 Supply chain barriers

Applying Lean practices to an organisation will increase operating efficiencies and reduce costs and waste. Yet for Lean to be fully effective, it should be applied across the entire supply chain. Many organisations will focus on implementing Lean in the areas where they have direct control (i.e. internally) rather than attempting to view the supply chain and look at where Lean can be more externally focused.

However, applying Lean practices in this way raises questions about who benefits from this. Ideally the benefits of a Lean supply chain, including reductions in excess inventory, waste and therefore cost, will be shared across all organisations participating. In practice this may not be the case. For example, a supplier may need to hold inventory for a client which will increase the supplier’s costs. These increases should, however be offset by reductions in other areas of the supply chain and the supplier should be compensated for additional costs. Operating Lean principles in this way requires fair and direct collaboration across all supply chain partners.

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b Personal communication, August 2011
c Qualitative report on SMEs on the role of Lean and resource efficiency in the UK food and drink industry, 2013, undertaken as part of this research
7 Implementing and promoting resource efficiency through Lean

Although the food and drink sector may appear to be less developed in its use of Lean than industries such as automotive, much of the information needed to eliminate waste using Lean is already present. This may take the form of HACCP (Hazard analysis and critical control points) flow diagrams or environmental management systems, or exist in the heads and experience of employees. Lean projects seek to mobilise this information, allowing it to flow through the organisation. Part of the difficulty for companies embarking on Lean is implementation – why to use Lean and how to implement it.

As prices rise and resource efficiency becomes ever more important to the industry, the hope is that companies looking at using Lean will also have an appreciation of the associated environmental benefits, thus formalising the link between Lean and resource efficiency.

7.1 How to start with Lean

7.1.1 Assessing the business benefits

Lean is a well-known concept in industry, yet despite this, some companies are still unsure of the benefits of Lean (see above). Time spent assessing the benefits of Lean is invaluable as a precursor to implementation – what Lean projects are achievable, given company resources and motivation, and what added profits/ increased cash flow/ reduced costs will result. Although there are resources available to assess the quantifiable benefits of Lean for commercial gains, there is very little opportunity to estimate resource efficiency savings. Given this lack of an available evidence base, companies should normally do - look to the commercial business benefits in the first instance. The BIS-funded Manufacturing Advisory Service (MAS, see Section 7.2.2) specifically offers this service. MAS visits a company and then produces data on GVA which is a projection of what they think will be the outcome of their support, calculated from projected turnover, profit, salaries and so on. They measure the gap before and after to arrive at a figure for growth.

Although resource efficiency will undoubtedly result from Lean projects, those companies which take the time to incorporate the identification of environmental improvements in the planning stage will be at an advantage. By measuring both the business and environmental savings, there is the opportunity to build up a body of data, currently lacking in the industry. Being able to use this data for future projects will increase success levels and also provide a series of concrete savings to strengthen a CSR profile.

7.1.2 Deciding on a strategy

Before getting to the detail of a project, a decision needs to be taken at management level as to the scope and breadth of any Lean project. What resources are available, internally and externally, to equip the project, and how will Lean leverage existing process improvement and business processes?

A Lean project will be most valuable if it addresses company goals and KPIs, and if there is an understanding of the savings available and whether this justifies the commitment. At this point, Lean should build on existing processes, not fight against them – a Lean project requiring data that an accounting package cannot deliver will tend to be unsuccessful. Figure 39 shows the questions to be asked before contemplating a Lean strategy.
In a sense, it is a case of deciding on which tier of the Improvement Pyramid to start and finish. The vast majority of companies do – and must – start at the bottom tier, with a single project to act as a trial. Many industry Lean consultants interviewed for this research stated that companies, especially SMEs, are advised to start gently. One interviewee advises SMEs thinking of doing Lean to “dip their toe into the water” on one small project and prove it works, then roll it out slowly – often the one-off projects can bring a high level of opportunities to SMEs in any case, as shown in Figure 40. Here the one-off projects have a high opportunity level for SMEs and require a smaller culture change. An SME with five employees will find it is easier to motivate the small workforce to work in new ways, due in part to short communication channels and a hands-on leadership example, whereas a large business needs more structural cultural changes to be rolled out in order to motivate the whole workforce, thereby achieving the highest benefits.

This gradual approach generally works better, regardless of company size, in changing the mentality of the company rather than telling everyone ‘we’re going Lean overnight’. Care must be taken that this does not become a ‘sheep-dipping’ approach, trying to force-fit a project onto people. Kellogg’s had a false start with their Lean approach when employees felt that sudden exposure to Lean was another
management initiative and were resistant to it. When Lean was rolled out across the company by external consultants, in a more blanket way, then the K-Lean approach suddenly took off.

### 7.1.3 Planning a project

Planning follows on from the decision about the level at which to embrace Lean. Lean projects work far better with in-depth, prior planning. This prioritises the opportunities and avoids valuable resources being committed unnecessarily, i.e. ‘busy fools’. A common sense approach is not out of place here, however. Applying the techniques of Lean – the planning and problem identification – to a common sense approach can be an excellent way to start. As common sense suggests, the way a project is tackled need not be complicated; if it is correctly planned, however, it avoids the pitfalls of knee-jerk fire-fighting reactions that often accompany ‘common sense’ approaches.

A mapping exercise, whether full value stream mapping or a simpler version, should form the basis of the planning. Most of the time spent on a Lean project should be dedicated to planning and problem identification. The DMAIC model also has ‘define’ as its starting point.

### 7.1.4 Choosing the correct Lean tools

Once identified, a problem can be solved using a variety of Lean tools. It may be fair to say that the exact Lean tool employed matters less than the type of tool and the knowledge of the team using it. A production line problem may be solved by data type tools - collecting and analysing data using Pareto charts or Six Sigma techniques. A store room problem may need a hands-on tool – a kaizen approach to visually sort, re-order and re-label stock. A foodservice company may find standard operating procedures to be the key to ensuring each server cooks and operates equipment in a uniform manner to avoid waste.

Online advice – for example from the Lean Institute or published literature – training courses and external consultancies are all valuable sources of help for learning about Lean tools.

### 7.1.5 Measuring progress

All Lean approaches stress measurement as being a vital part of a project. Meaningful measurement provides the basis for monitoring performance, and a way of communicating this performance within the organisation. Improvements made during a Lean project can be captured by KPIs, ensuring that processes do not simply slip back to how they were. Measuring is therefore important in embedding Lean. Measuring associated environmental benefits is rarely done, but will bring future competitive advantage to companies. As resources become fewer and more expensive, those organisations that have started measuring and identifying their levels of resource efficiency will be better placed to undertake environmental improvements, resulting in tangible cost savings.

### 7.1.6 Taking Lean further

Once Lean projects become well established and employees begin to see the value in such projects, there is the opportunity to take Lean further. Lean can become the standard way of problem-solving, moving an organisation to the second tier of the Lean Improvement Pyramid. Lean training is regularly provided, and all employees are encouraged to monitor their processes for ways to reduce waste using Lean. This systemised approach to Lean may be driven by the company, or may evolve over time once knowledge becomes embedded.

Moving to the higher tier of Lean, the full Lean Culture, requires a more focused strategy from top management. Management of change becomes the key to changing the way people in a company think about their organisation. Lean spreads upstream and downstream in the supply chain, requiring suppliers

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* Personal communication, Kellogg’s, 2012
and customers to become partners in Lean initiatives. Developing the cultural framework for this change can be done quickly, given adequate resources; establishing the team-based, continuous improvement environment amongst employees generally takes years.

Weaving resource efficiency into the fabric of Lean culture is at the cutting edge of Lean; the most forward thinking companies are already doing this. The fact that it has been assigned resources, amongst all the other demands on a company, signals that they, at least, feel the time and money spent doing this is extremely worthwhile, and will bring commercial gain.

### 7.2 Sources of help

#### 7.2.1 Helping SMEs adopt Lean

Given the large number of SMEs in the food industry, using Lean to increase the collective resource efficiency of smaller businesses would produce significant improvements. Evidence from the interviews for this study suggests that SMEs are sufficiently flexible to change but lack basic understanding of the benefits of Lean². SMEs appear as resistant to new ideas and changing existing processes as larger food organisations; this resistance is fuelled by the possibly irrational fear of wasting time and financial resources, even if only in the short term. Given a better understanding of Lean, these barriers may be removed and allow process improvements to be embraced as a valuable commercial strategy.

A minority of the interviewees had heard of ‘Lean thinking’, ‘Lean production’ or ‘Lean journey’. Where this was the case, their knowledge stemmed from their studies or from previous employment, rather than from current application of Lean practices at work. The sole exception was a business linked with the local council, which had received a visit from the council’s Lean team to lean their administrative operations.

Whilst some SMEs easily understood the benefits of Lean when it was explained to them, others felt that it was simply common sense and that all SMEs were doing such activities. Therefore, it might be useful to open up a dialogue that gradually introduces the nuances of Lean by building on the SMEs’ current understanding and perceptions, rather than attempting a sudden overhaul in their way of thinking. Allowing them to take incremental steps towards implementing Lean is a strategy that is most likely to succeed, based on the SMEs interviewed for this research. Theory suggests that framing the Lean opportunity around ‘losing money’ as a result of wastes that are currently invisible and avoidable – rather than ‘saving money’ – may help to overcome the fear of change. However, this would need to be tested further because the SMEs interviewed for this research seemed to be sceptical that they are losing significant amounts of money through inefficient practices and they tended to react defensively to implied criticism of their business model.

The concept of ‘customer value’ may offer a promising starting point for engaging SMEs in thinking about Lean. This is a concept that strongly resonates with SMEs, and could offer a fresh angle for discussion, following the recent focus on ‘cost-cutting’ or ‘cost savings’ that has been prevalent in many recent resource efficiency communications. Gradually building on the concept of ‘customer value’ and enhancing SMEs’ understanding of it could encourage them to begin leaning their operations.

To encourage SMEs to implement some initial, basic Lean behaviours and build competencies for resource efficiency, it may be worth starting by building on what they already do, and drawing on examples of good practice from their peers, to help overcome some of the barriers listed above. Examples from the interviews of the kinds of ‘small steps’ that SMEs could potentially be encouraged to take include:

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² Evidence from interviews with 16 SME companies undertaken for this research
• Standard operating procedures which are geared towards resource efficiency – examples from this research include using a ladle to measure portions and grouping cakes into batches by baking temperature;

• More formal continuous improvement mechanisms – for example, one of the interviewees decided at the end of his interview that, rather than assuming staff will proactively make improvement suggestions if they have any, he would begin asking staff for this kind of feedback at their weekly team meetings; and

• Basic value stream mapping, which incorporates the kinds of things that SMEs are already thinking about (e.g. staff, finances) but also, crucially, the resources that are currently not on their radar.

It will be vital, as part of this dialogue, to think carefully about how Lean and related concepts are defined and presented. This research has shown that an apparently straightforward definition can be, and often is, easily misconstrued. A balance needs to be struck between ensuring that the concepts are not misunderstood, but the definitions used still allow SMEs to build on their existing beliefs and perceptions about Lean without being seen to tell them what to do and how to do it. Crucially, SMEs need to be empowered to draw their own conclusions about the ways that Lean can help them improve their business – unsolicited external advice is easily dismissed as irrelevant to the type or size or set-up (or any number of other characteristics) of the business.

**SME Intervention points**

Empowering SMEs to think about and act on Lean is likely to be more successful if they can be encouraged to do so at a time when they are most receptive to incorporating new ideas. This research has identified some clear differences between smaller and larger SMEs, and between younger and more established SMEs, which suggest that there may be ‘growth points’ in an SME’s lifecycle, at which it is actively making changes to its processes – and at which Lean principles could be incorporated into those processes. Most of the time it would appear that SMEs’ processes are relatively inert: the SME has identified an approach that works ‘well enough’, and changing this approach would be perceived as an unnecessary hassle with time or cost implications. The two ‘growth points’ that form the exceptions are:

• When a young SME is becoming more established, and learning the ‘best ways’ of doing certain tasks. What seems to happen in these cases is that the owner/manager realises that, of various ad hoc approaches to a task, some work better than others. Although this does not necessarily lead to standardisation, or even to the most efficient approaches being adopted, it is a step in that direction as some old practices are discarded.

• When a small SME grows past the point where the owner/manager has a full overview of every aspect of the business, and begins to need to delegate. In these cases, in order for the owner/manager to retain control over how the business operates and how certain tasks are carried out, some degree of standardisation is often introduced into business and operating processes. At the same time, there is a risk that certain Lean capabilities may be lost at this stage, as business management becomes less integrated.

In addition, when an SME is initially being set up, there may be scope to introduce Lean thinking into the business from the very early stages, so that Lean practices are instilled in the business from the start and can grow with the business. Lean behaviours are, however, likely to look different in SMEs of different ages and sizes, and even if Lean is introduced at the start-up stage, there may be a need to revisit it at key growth points later on.

These growth points provide key opportunities to ensure that the changes made, and the initial business processes set up, are not just ‘good enough’ but that they are truly Lean, as well as being geared towards resource efficiency.
7.2.2 Manufacturing Advisory Service

The Manufacturing Advisory Service (MAS) is a national service delivered locally by experienced advisors, who help manufacturers grow their businesses\(^a\).

MAS Advisors work with manufacturers at strategic level to create business and product strategies, to develop a culture of innovation and generate new product ideas and market opportunities. They are also equally at home working with shop floor teams to identify and reduce waste and help them maximise profitability in their own business and supply chains.

MAS is well placed, therefore, to provide support for Lean projects whilst also encouraging resource efficiency.

MAS currently operates by offering a free initial review, then subsidised follow-up support. All of the Advisors have extensive experience of working in industry and are able to advise on all Lean tools and approaches including:

- value stream mapping
- cellular manufacturing
- mass balance mapping
- workplace organisation
- process innovation.

MAS produces an initial estimate of the scale of the opportunity, in economic terms, before commencing a project. This concrete and practical way of highlighting potential cost savings is extremely valuable to SMEs, as understanding possible financial benefits is often the first step to implementing Lean.

MAS has helped many SMEs and has case study information dating back to 2002. From the period 1st January 2012 - 31st March 2013, MAS has carried out 270 in-company reviews that resulted in 170 support projects being completed in more than 140 small and medium sized (0-249 employees) food and drink manufacturing businesses in England.

Motivating factors for SME manufacturers to approach MAS for support include:

- they are ‘in trouble’
- they have just received a huge order and need advice on how to deliver
- they want to put in a new process
- they have a quality problem
- they have a yield loss (i.e. general waste) problem
- they want assistance in developing long-term business strategies.

Some of the case studies supplied to the project team by MAS include examples of companies who, after initially contacting MAS for commercial reasons, then went on to work with them to address environmental issues (see case study on Olives et al., Section 6.4.6).

7.2.3 UK industry and supply chain initiatives

Retailers or manufacturers see a competitive advantage in helping suppliers to cut their costs and improve resource efficiency. One UK manufacturer of processed food products stated that “it is no longer a case of one food business competing with another food business; now it is about supply chains competing with each other”\(^b\). To this end, this business ‘Leaned’ its packaging provider, stabilising the

\(^a\) Manufacturing Advisory Service, 2012

\(^b\) Personal communication, January 2013
supply of commonly-needed products. The improved efficiency benefited both parties. Keen to share good practice, the company - which has doubled turnover in the last six years - invites outsiders (although not competitors) to see ‘Lean in action’ at its facility. This continual challenge to their systems reportedly prevents complacency. One of its major suppliers, based overseas, was so impressed with the company’s approach that it now ‘Leans’ its operations in a similar way.

Most of the large retailers, foodservice providers and manufacturers interviewed for this project referred to having schemes in place to improve their supply chains. The evidence suggests, therefore, that food companies are most likely to be exposed to Lean (or continuous improvement) through supply chain initiatives. This is the most common factor in pushing companies to seek external help, whether that be from consultants or government advisory services.

7.3 Promoting the link between Lean and resource efficiency

Conveying the wider message of the synergy between Lean and resource efficiency is a task suited to the government department Defra and its delivery body WRAP. Defra plays a pivotal role in encouraging sustainable improvement in the food and drink industry. There is recognition that sharing resources through strategic initiatives is central to continued knowledge generation; co-operation and collaboration between all companies, but particularly retailers and large foodservice businesses, is key. Commercial sensitivities can cause reluctance for organisations to share best practice; one of Defra’s roles is to facilitate these industry partnerships and allow information to be shared whilst not undermining such competitive advantages.

Waste Resources Action Programme (WRAP)

WRAP is a non-governmental organisation funded by Defra, and which acts as Defra’s delivery body. While some of the wider published advice on Lean and resource efficiency is not tailored to specific industry sectors (for example the US EPA in section 8.4 below), WRAP does have a focus on the food and drink retail supply chain. The delivery body is developing a problem-solving discipline around waste as a tool, which will formalise the approach it takes with businesses. During 2013, WRAP will publish good practice guidance derived from waste prevention reviews and implementation activity undertaken in recent years. As discussed in Section 5.6.3, WRAP also recently funded projects led by IGD which used Lean tools to cut supply chain waste. This level of activity helps to validate Lean as a vehicle for resource efficiency, as well as to begin building up a body of much needed quantifiable evidence.

US EPA initiatives

As discussed in Section 4.4.2, the US EPA has actively used Lean as a tool to convey the sustainability message to business for more than a decade now. The organisation, which is primarily a regulator (the equivalent of the Environment Agency in England & Wales), has produced papers, guidance and toolkits on ‘Lean and green’. These could set the standard for other bodies, including those in the UK, seeking to promote change. The US EPA lists the key learnings of their approach as:

- A recognition that Lean is driven by competitiveness, and environmental considerations need to be integrated into Lean, as opposed to diverting Lean away from its cost drivers.
- Lean brings the largest environmental benefits when environmental professionals are invited to participate fully in operational Lean initiatives, avoiding operations, quality and environmental teams functioning in parallel universes within the same company.
- Lean and Six Sigma operate on a continuous improvement principle which is very conducive to eliminating environmental waste and driving sustainability. However, there are environmental ‘blind spots’ with Lean, such as environmental risk (how toxic is a product?) and lifecycle considerations (how are the raw materials procured, and how is the end product/packaging disposed of?).
It is clear that the US EPA has invested considerably in highlighting the link between Lean and ‘green’. Feedback, both from the US EPA themselves, and external stakeholders, appears positive, although there has been no economic or resource efficiency quantification of their influence. To appreciate the true impact of the US EPA’s Lean programme, and the extent to which it can influence UK policy, there would need to be more evidence relating to the take-up of the advice.

Despite this caveat, the strength of the US approach is perhaps in its openness to allow material to flow into the public domain, and be picked up by industry. The Lean Enterprise Institute (www.lean.org) provides Lean guidance broken down by sector, organisation size and type. Although a US website, it provides a good starting point for acquiring basic knowledge of Lean. Several individuals spoken to during this research mentioned the site as having been a useful first exposure to Lean.
8 Conclusions

One of the key discussion points at the start of this study was the fundamental question on how to define Lean. Should the study focus on Lean in its purest form as transcribed in the Toyota learnings, or should it take a broader view, embracing a more general ‘continuous improvement’ approach? To overcome this difficulty, the Lean Improvement Pyramid was developed to enable an assessment of the full spectrum of Lean intervention/application within the food sector, from common sense improvements to full Lean culture change. A summary of the findings is shown in Table 13:

**Table 13: Resource efficiency benefits from a Lean approach**

<table>
<thead>
<tr>
<th>Lean stage</th>
<th>Methodology</th>
<th>Resource efficiency benefits of using Lean – best available evidence</th>
<th>Commonly used Lean tools</th>
<th>Potential associated resource efficiency gains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean culture</td>
<td>Fully Lean organisation; all processes optimised for waste minimisation. VSM used at its most powerful, to improve supply chain efficiencies.</td>
<td>14.5% reduction in red meat raw materials waste&lt;sup&gt;b&lt;/sup&gt;</td>
<td>VSM/mapping of entire supply chain; 6s DMAIC; Supplier scorecards; Lean driven by all employees; Plus all tools used at the other two levels.</td>
<td>Large scale savings across all products or distribution channels: Specific, measured carbon/water/ energy reductions; Large scale carbon savings via optimising delivery networks; Driving waste reduction via supplier scorecards.</td>
</tr>
<tr>
<td></td>
<td>More formal Lean programme; time spent planning projects and embedding results with SOPs. VSM widely used at internal process level.</td>
<td>8.6% reduction in red meat raw material waste&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Kaizen (pre-planned event); VSM (mapping a process); 6s DMAIC; SOPs and KPIs to embed learning; CI/Lean teams Plus tools used at previous level.</td>
<td>Starting to get significant RE savings through roll-out Lean programmes: Knowledge integration via IT = reduction in paper etc; Waste and energy savings through targeted projects; Water reduction through increase measurement; Lean stock management = better use of space and energy.</td>
</tr>
<tr>
<td></td>
<td>Use of a few Lean/Lean-like tools to solve specific problems; approach may be reactive.</td>
<td>Maximum 5%</td>
<td>Kaizen (one-off problem blitz); CI meetings; Led by single expert or external consultant.</td>
<td>Useful but isolated RE benefits: Less waste to landfill; Small savings in water/ energy from refining production processes; Better ‘housekeeping’ = less wasted packaging etc.</td>
</tr>
</tbody>
</table>

This study shows that the majority of organisations that are using Lean in the food sector have done so by simply applying specific Lean tools to existing working practices. The Lean tools that are commonly used include; Kaizen, to tackle a poor performing stage in the process; or SMED, to speed up changeovers. In the case of SMED and many of the other tools, the term itself has not been readily adopted by the sector, although the basic principles have. The study shows that problem solving tools are the most likely Lean

<sup>a</sup> Each level includes the tools used at the level below as a given
<sup>b</sup> See 5.4.3: results from quantified red meat study
intervention at this stage and that there is a lack of sophistication in the planning process to identify the priority opportunities.

Organisations that have fully embraced Lean have gained most in terms of identifying and realising savings. Much of this is down to the advanced planning systems that are used (for example, VSM or Six Sigma to identify hotspots, quantify the savings opportunities, and prioritise interventions).

One common theme throughout the Lean Improvement Pyramid is that many organisations find that translating the principles behind Lean into a simple 'common sense' approach significantly increases the likelihood of adoption.

### 8.1 Supply chain engagement

To date, many of the organisations that have adopted Lean have done so internally on an individual, case-by-case basis. This has been driven either by an individual who studied Lean or has come from an industry using Lean; an organisation that is in financial crisis or needs to improve its competitiveness; or is a global corporation where Lean is embedded into the corporate culture. However, the industry is in transition and many of the retailers and other big players in the market are now driving Lean externally throughout their supply chains. Example organisations include M&S and McDonalds. This is very similar to the natural progression of Lean in the UK automotive sector in the 1970s.

This switch of driver is changing opinion on where to start with Lean. Previously, a common approach was to encourage individual organisations to identify a quick win project, undertake a Kaizen blitz and celebrate/communicate the early success. The general opinion is now moving towards starting with VSM to provide a whole supply chain overview prior to focussing on individual projects. This helps to create competitiveness throughout the supply chain, not just in a single organisation.

For the food sector it is clear that out of life product is a key supply chain issue and would be one of the areas of focus within any VSM exercise. Figure 41 shows the shelf life losses at the retail stage.

*Figure 41: Out of date losses (volume) at retail stores, by product category*

See Table 6, Section 3.2.1, for sources
Figure 41 shows (unsurprisingly) that perishable food such as bakery and sandwiches have the greatest problems with shelf-life/expiry. Applying a mapping exercise to these specific categories would be a first step to reducing this level of waste. The more efficiently a product moves through the supply chain and reaches the retail shelves, the lower the risk that the product will reach its expiry date before being sold.

### 8.2 Lean versus ‘green’ – degrees of integration

Clearly, many parts of Lean fall directly into the ‘green’ agenda; resource efficiency and Lean are well matched in that they both follow a ‘making more with less’ approach. One of the topical debates is whether sustainability and/or resource efficiency can be fully integrated within Lean or if it should remain as a completely separate entity. The US EPA suggests that the environment should be included as the ‘eighth deadly waste’ within a Lean framework, whereas others have developed alternative approaches to sustainability that imitate the Lean approach: For example, SVSM, 8 environmental wastes and EPIs.

All the approaches encourage the use of Lean to link operations/production and environment/sustainability to some degree, however.

This study has found that the food industry, given its place at the beginnings of the Lean journey, is currently most likely to increase resource efficiency (reducing raw materials, energy and water) through a traditional Lean/CI approach, even if these savings are secondary or accidental to the main focus. Significant environmental benefits can be attained through Lean and the industry is ready to develop Lean programmes; with the exception perhaps of the larger organisations, most food and drink companies will lack the confidence and belief to implement a sustainable variation of Lean. As the industry embraces Lean to a greater degree and reaches the top of the Lean Improvement Pyramid, there may be a case for advocating green variations on Lean, such as Environmental Performance Indicators rather than simply Key Performance Indicators.

To conclude, the food industry is embracing the principles of Lean and has adapted it for use in a people-orientated sector. More can be done in harnessing the synergies of Lean and resource efficiency, and supply chain engagement is considered one of the most significant areas of opportunity going forward.
**Appendix 1: Industry input – interviews and case studies**

The tables below show the body of evidence collected from industry. The examples were categorised into a specific tier of the Improvement Pyramid to allow the project team to see at which level the majority of food and drink companies sat. Names have been left in only when the company has expressed a wish to be identified in the study.

**Lower Tier:**

<table>
<thead>
<tr>
<th>Name</th>
<th>Size</th>
<th>Type</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olives et Al</td>
<td>Small SME (46)</td>
<td>Food manufacturer</td>
<td>Project to improve desalination of olives</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Basic mapping tools</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Assisted by Manufacturing Advisory Service</td>
</tr>
<tr>
<td>Bread manufacturer</td>
<td>Large</td>
<td>Food manufacturer</td>
<td>Absence of correct problem identification</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reactive problem solving using Lean engineering fixes</td>
</tr>
<tr>
<td>Chocolate company</td>
<td>Small SME (under 50)</td>
<td>Food manufacturer</td>
<td>Driven by owner expert in Lean from previous job. Uses simpler tools like Lean Process Engineering which is just ‘common sense’ to streamline all her processes. Examples include getting things right first time.</td>
</tr>
<tr>
<td>Wine distributor</td>
<td>Large</td>
<td>Distributor</td>
<td>Some use of Lean for obvious problems; more emphasis on technology; no systemised approach</td>
</tr>
<tr>
<td>Food producer</td>
<td>Large (2,000)</td>
<td>Food manufacturer</td>
<td>No experience of Lean as such; uses environmental system to reduce waste</td>
</tr>
<tr>
<td>Foodservice</td>
<td>Large</td>
<td>Distributor</td>
<td>Focuses on major problems when they arise</td>
</tr>
<tr>
<td>Hotel</td>
<td>Large chain</td>
<td>Foodservice</td>
<td>Used consultants to Lean one element of menu planning</td>
</tr>
<tr>
<td>Processed food</td>
<td>Large</td>
<td>Food manufacturer</td>
<td>Production based problem solving using Lean tools</td>
</tr>
<tr>
<td>manufacturer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinks manufacturer</td>
<td>Multinational</td>
<td>Drinks manufacturer</td>
<td>Surprisingly uninterested in Lean given its size; pressure by customers to ‘do Lean’. Does some on-going CI.</td>
</tr>
<tr>
<td>Leisure business</td>
<td>Medium SME (120)</td>
<td>Foodservice</td>
<td>One of the 16 SMES interviewed for this research. For reasons of confidentiality, individual company approaches to Lean cannot be identified but have been collectively summarised in the full report</td>
</tr>
<tr>
<td>Delicatessen/café</td>
<td>Micro (10)</td>
<td>Foodservice</td>
<td>As above</td>
</tr>
<tr>
<td>Café/sweetsop</td>
<td>Micro (6)</td>
<td>Foodservice</td>
<td>As above</td>
</tr>
<tr>
<td>Caterer</td>
<td>Micro (5)</td>
<td>Foodservice</td>
<td>As above</td>
</tr>
<tr>
<td>Restaurant</td>
<td>Micro (5)</td>
<td>Foodservice</td>
<td>As above</td>
</tr>
<tr>
<td>Leisure</td>
<td>Small SME (50)</td>
<td>Foodservice</td>
<td>As above</td>
</tr>
<tr>
<td>Wholesaler</td>
<td>Small SME (11)</td>
<td>Distributor</td>
<td>As above</td>
</tr>
<tr>
<td>Shop</td>
<td>Micro (10)</td>
<td>Retail</td>
<td>As above</td>
</tr>
<tr>
<td>Caterer</td>
<td>Medium SME (100)</td>
<td>Foodservice</td>
<td>As above</td>
</tr>
<tr>
<td>Distribution</td>
<td>Large SME (185)</td>
<td>Distribution</td>
<td>As above</td>
</tr>
<tr>
<td>Caterer</td>
<td>Large SME (200)</td>
<td>Foodservice</td>
<td>As above</td>
</tr>
<tr>
<td>Restaurant</td>
<td>Small SME (20)</td>
<td>Foodservice</td>
<td>As above</td>
</tr>
<tr>
<td>Caterer</td>
<td>Small SME (15)</td>
<td>Foodservice</td>
<td>As above</td>
</tr>
<tr>
<td>Butcher</td>
<td>Small SME (18)</td>
<td>Retail</td>
<td>As above</td>
</tr>
<tr>
<td>Bakery</td>
<td>Micro (1)</td>
<td>Retail</td>
<td>As above</td>
</tr>
</tbody>
</table>

For Defra
Middle Tier:

<table>
<thead>
<tr>
<th>Name</th>
<th>Size</th>
<th>Type</th>
<th>Approach</th>
</tr>
</thead>
</table>
| Processed food manufacturer | Large (450)| Food manufacturer  | Use of VSM to identify priority opportunities  
Dedicated CI team                                                                                                                         |
| Kellogg's                   | Multinational | Food manufacturer | Started to roll out Lean programme in 2008/9                                                                                                  |
| Ready meals manufacturer   | Multinational | Food manufacturer  | Value Stream Mapping, End-to-End Supply Chain Mapping, Demand Forecasting to develop a ‘Current State Map’.  
Driven by retailer Lean programme                                                                                                           |
| Alcoholic drinks            | Large      | Drinks manufacturer | Does Lean and CI internally; does not ‘get involved’ in the supply chain                                                                       |
| Foodservice company         | Large      | Distributor/manufacturer | A system of CI, not so familiar with Lean. Good RE targets set; no mention of culture change                                           |
| Retailer                    | Large      | Retail             | CI more than Lean                                                                                                                                                                                      |
| Bottling factory            | Arm of a multinational | Drinks manufacturer | Production is highly Lean; not yet including the supply chain                                                                                     |
| Cereal manufacturer         | Large      | Food manufacturer  | Rolling out a Lean programme rapidly                                                                                                           |

Higher Tier:

<table>
<thead>
<tr>
<th>Name</th>
<th>Size</th>
<th>Type</th>
<th>Approach</th>
</tr>
</thead>
</table>
| Grocery retailer  | Multinational | Retailer   | Full scale mapping of supply chain  
Culture of continuous improvement                                                                                                           |
| M&S               | Multinational | Retailer   | Supplier improvement programme  
Plan A initiative                                                                                                                              |
| McDonald's        | Multinational | Foodservice | Supplier scorecards  
Highly standardised processes across international boundaries                                                                                    |
Appendix 2: Food safety and standards

Food safety and standards were identified as possible areas which may facilitate or drive the uptake of Lean in the food and drink industry. The sections below present an overview of food safety (HACCP) and some of the main ISO standards which may be applicable to the food and drink industry. They have been included in the Appendix due to the fact that very little evidence was found of any companies using either area to drive Lean practices.

Food safety
As suggested in Section 6.8, existing procedures for ensuring food hygiene and safety may lay the groundwork for the adoption of Lean thinking. Many food and drinks companies across the supply chain use HACCP. This is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product. HACCP centres on the identification of critical control points – stages in a process at which controls can be applied to reduce or eliminate food safety hazards. This typically involves a detailed mapping of the process and this methodology bears strong resemblance to a VSM. Existing HACCP management behaviours could thus potentially be used as a foundation for Lean initiatives. The process flows utilised in HACCP can not only act as a vehicle for sustainability improvements, but also take a PDCA approach to improvements, in line with the CI terminology of Lean. Although such a synergy has been suggested by a UK sandwich manufacturer, no evidence was found of any type of business, either here or abroad, seeking to integrate Lean with HACCP.

Standards
Introduction
Like HACCP, the widespread use of internationally-recognised standards in the food and drinks industry may also facilitate the adoption of Lean thinking. The emphasis on continuous improvement is common to both Lean and to many standards. Moreover, the standardisation and stabilising of processes is sometimes considered a necessary first step before formal Lean tools can be applied. This is especially true in parts of the industry experiencing rapid product turnover. The UK manufacturer Bakkavor stresses that management effort should focus initially on ‘training and standards’ so as to get a ‘stable foundation in place’, with ‘problem-solving’ and other tools and techniques such as ‘changeover reduction’ introduced later as appropriate.

Others suggest, however, that Lean tools can themselves be used for introducing standardised working methods. For instance, the cereal manufacturer Kellogg’s reports the use of 5S for “developing discipline and standards in workplace organisation” while SMED is used to standardize changeovers. Similarly, another food processor claims to have made important gains through the implementation of standard work, including in the administrative areas. The company uses ‘visual standards’ and SOPs, so that an inspection of any part of the operation, e.g. consumable packaging, raw materials, production, finished products, would reveal instantly whether anything was wrong. While generally commending their use, a US-based Lean consultant finds that, by their nature, standards can drive overwork and overproduction in order to comply with them, which might contradict Lean principles.

http://www.fda.gov/food/foodsafety/hazardanalysiscriticalcontrolpoints/haccp/default.htm

Personal communication, January 2013

Tony Swindell, Bakkavor telecom, January 2013

Richard Burkinshaw & Albert Roch, Kellogg’s telecom, October 2011

Personal communication, 24.10.11

Personal communication, 21.1.13

Personal communication with US Consultant, January 2013
The research undertaken for this report found no evidence for direct linkages between Lean and any standards in order to drive better resource efficiency. However, should the association in the future be formalised, standards may be an effective way for larger actors in the food and drink industry to drive change across the supply chain. Research for Defra in 2011\(^a\) found that smaller SMEs were encouraged to adopt environmental management systems (typically guided by standards such as ISO 14001) in order to win business with new, large customers.

Some of the more relevant standards are briefly reviewed below.

**ISO 9001 – Quality Management**

ISO 9001 is among the most widespread and internationally-recognised certifications in industry. Quantum Associates, a US-based Lean consultancy, argues that companies with ISO 9001 are ideally placed to adopt Lean, because “Lean works best when it is built on the solid framework of stability, standardization and simplification ... Kaizen, a Lean tool, can be incorporated into the project management tool in order to engage your entire organization in ISO 9000 compliance and continual improvement”\(^b\). In addition, the audit process in Six Sigma is comparable with an ISO 9001 audit and like Lean, the standard focuses on price, quality and service, while requires senior management input and commitment.

**FS 22000 – Food Safety**

FS 22000, also known as FSSC 22000, is specific to food manufacturing, incorporating food hygiene, safety and traceability into a quality management system.\(^c\) The standard includes such factors as:

- layout of premises and workspace;
- utilities – air, water, energy;
- waste disposal;
- equipment suitability, cleaning and maintenance;
- management of purchased materials;
- measures for prevention of cross contamination;
- cleaning and sanitising; and
- warehousing.

FS 22000 may thus be more appropriate than ISO 9001 to Lean, although no evidence was found in the food and drink industry for an integration of this standard with Lean approach.

**ISO 14001 - Environmental Management**

In the area of natural resource efficiency, standards - of which ISO 14001 is the most notable - guiding the establishment and running of environmental management systems (EMS) are widely used across many industries including food and drink, and incorporate several Lean principles (Figure 42).

---

\(^a\) Hillary, R and Burr, P. (2011) *Evidence-based Study into the Benefits of EMSs for SMEs*, WYG Environment, commissioned by DEFRA

\(^b\) Willie L. Carter (n.d.) *Leveraging ISO 9000 To Jump Start Your Lean Journey*. Website: [http://www.quantumassocinc.com/Lean%209000REV.pdf](http://www.quantumassocinc.com/Lean%209000REV.pdf)

\(^c\) Numeral Advance (n.d.) *LEAN SIGMA IN FOOD PROCESSING*. Website: [http://www.numeraladvance.com/Qualite__Business_et_IT/Pratiques_Lean_et_Six_Sigma/Lean_Sigma_in_food_processing/Lean_Sigma_in_food_processing.htm](http://www.numeraladvance.com/Qualite__Business_et_IT/Pratiques_Lean_et_Six_Sigma/Lean_Sigma_in_food_processing/Lean_Sigma_in_food_processing.htm)
The frozen ready-meal company apetito confirms that ISO 14001 fostered a pre-existing continuous improvement culture in the organisation\(^a\). But again, numerous contacts with stakeholders uncovered no evidence that businesses in this, or other sectors, are formally integrating this standard with Lean approach. Rather, as discussed elsewhere, managers responsible for implementing EMSs are generally not involved in the parts of the organisation where Lean decisions are taken (e.g. in the operations or supply chain departments).

**ISO 13053 - Quantitative methods in process improvement – Six Sigma**

Until recently no single, universal method was available for the application of Lean principles themselves. Instead, organisations and individual practitioners develop and use their own methods\(^b\), adopting some tools and ignoring others, depending on the problems that need addressing, or the industry in question. However, in 2011 the first international standard was launched in the area of Lean thinking. ISO 13053, as it is known, claims to set out best practice for applying Six Sigma comprising the five phases of DMAIC: define, measure, analyse, improve and control. In addition to improving manufacturing, ISO 13053 is applicable to service and transactional processes\(^c\). Professionals such as Paloma Consulting who are experienced in Six Sigma training, and who have been in the industry a long time, welcome the new standard as addressing a decline in the quality with which Six Sigma is taught and practised\(^d\). However, in general Six Sigma specialists acknowledge that it remains to be seen as to whether the standard will make an impact. Currently, no audit or certification is tied to this standard which somewhat weakens its credibility. Nevertheless, ISO 13053 provides a framework for the future, should further attempts be made to standardise the approach. No examples were found of UK food and drinks companies adopting ISO 13053, so its contribution to resource efficiency is unknown.

\(^a\) Personal Communication, apetito, November 2011
\(^b\) Chris Reed & Mitch Kidwell, US EPA, January 2013
\(^c\) http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?ics1=03&ics2=120&ics3=30&csnumber=52901
Appendix 3: The hotspots report
FO0425 – Lean Thinking in the Food Chain
Phase 1 Report: Resource & waste hotspot identification
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For Defra
Glossary

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C&amp;I</td>
<td>commercial and industrial</td>
</tr>
<tr>
<td>EMDA</td>
<td>East Midlands Development Agency</td>
</tr>
<tr>
<td>GHG</td>
<td>greenhouse gas</td>
</tr>
<tr>
<td>HGV</td>
<td>heavy goods vehicle</td>
</tr>
<tr>
<td>ktoe</td>
<td>thousand tonnes of oil equivalent</td>
</tr>
<tr>
<td>ktSO₂e</td>
<td>thousand tonnes of sulphur dioxide equivalent</td>
</tr>
<tr>
<td>LGV</td>
<td>light goods vehicle</td>
</tr>
<tr>
<td>MtCO₂e</td>
<td>million tonnes of carbon dioxide equivalent</td>
</tr>
<tr>
<td>Mtoe</td>
<td>million tonnes of oil equivalent</td>
</tr>
<tr>
<td>QSR</td>
<td>quick service restaurant</td>
</tr>
</tbody>
</table>

Units: Conventional SI units and prefixes used throughout: (k, kilo, 1000) (M, mega, 1,000,000) (G, giga, 10⁹) (kg, kilogramme, unit mass) (t, metric tonne, 1000 kg)

Context of this Report

This module is a component of the Phase 1 report of the FO0425 project. It comprises a stand-alone section to aid distribution and review of the entire report, within which this module is reproduced in full.

The topic of this module is the identification of so-called hotspots within the food supply chain from farm gate to delivery of food or food service to the consumer. Hotspots have been defined as points where large resource impacts are reported to occur within the supply chain, a convention applied by WRAP. This differs from Defra’s definition which is taken to mean points where significant opportunity to reduce resource impacts can be identified. For the purposes of this module we have adopted WRAP’s definition both for consistency with other work and because – in truth – there is little supporting research for such analysis.

Other stand-alone sections:

- FO0425-P1-Manuf-Fill: Review of sector activities – manufacturing & filling – Section 6
- FO0425-P1-Retail-Dsn: Review of sector activities – retail & distribution – Section 7
- FO0425-P1-FoodService: Review of sector activities – food service – Section 8

Conventions used in this report

Bibliographic sources are cited in numerical order thus (2 p xx). Private communications are referenced uniquely by consultant initial and id number thus (DE009).
1 Overview

1.1 Aim and Methodology

The aim of the hotspots module is to provide Defra with a broad picture of the environmental impacts across the food supply chain. Its purpose is to help refine and focus on particular areas and hotspots and the extent to which lean methods are addressing these identified hotspots.

When coupled with known priorities and concerns, this might be used to generate a map of ‘hotspots’ i.e. where impacts are at their greatest and deserve attention. An overlay to this information is the findings of where attention has apparently already been focused and improvements made; or indeed where it is apparent that little attention and improvement has occurred.

This report summarises the data available on resource use in the food supply chain in four key areas:
- Energy use and greenhouse gas emissions
- Waste generation and management
- Water consumption
- Emissions to air.

The evidence-gathering and review has embraced printed materials, electronic publications and ‘grey’ sources. The search for evidence has taken three approaches: email sent to a wide range of stakeholders, a direct one-to-one contact and interview programme, and an electronic search of published literature.

a) The Nature of the Evidence

Before presenting the analysis, here are some general opinions on the nature of the evidence.

This phase of the work consists of a review of evidence, the purpose of which is to understand enough of the current situation to suggest where further investigation is warranted. No primary research has been undertaken with the aim of filling any of the apparent evidence gaps. (Particular evidence gaps were observed for bakery and ambient products.) It is noted however that considerable further research regarding environmental hotspots is being undertaken by Defra and WRAP with respect to hospitality and foodservice, and on grocery products as part of the Product Sustainability Forum.

Two main types of evidence are observed in the literature for environmental impacts and hotspots, and this report is therefore structured accordingly. The first takes a sector or multi-sector approach for the use of different types of resources. The second approach focuses on hotspots for particular products and their associated supply chains.

The specificity of the evidence varies considerably by resource type:
- Energy use: data is relatively detailed at highlighting the major energy-using processes and to some extent the sub-sectors or products associated.
- Greenhouse gas emissions: carbon footprinting has provided much data on the emissions associated with each stage of the supply chain. This data shows that although raw materials generally account for the largest share, there are hotspots at other stages of the supply chain.
- Waste: data is generally only available at a relatively high level focussing on the quantity, composition and management of waste. Little distinction is made between the types of food waste or on its causes, and there are gaps in the data collected e.g. liquid wastes, SMEs, wholesalers etc.
- Water: recent data has addressed the water footprint embedded within food and drink products, although the focus has been predominantly on water use in agriculture. There is very limited actual data on the direct use of water within other stages of the supply chain, but that that there is seems to confirm agriculture as representing the major hotspot.
2 Resource Use in the Food Supply Chain

2.1 Energy Use & Greenhouse Gas Emissions

2.1.1 Supply Chain

The UK food supply chain was estimated for 2007 to have consumed 45 Mtoe of primary energy and generated 160 MtCO$_2$e of greenhouse gas emissions (around 22% of the UK’s total emissions). Figure 43 shows the breakdown across the food supply chain. Manufacturing, transport, retail and catering are collectively estimated to account for a total 40% of primary energy use and 27% of greenhouse gas emissions from the food supply chain.

Figure 43: Primary energy use (Mtoe) and greenhouse gas emissions (MtCO$_2$e) in the UK food chain, 2007

2.1.2 Food & Drink Manufacturing

With food & drink manufacturing, both energy usage and greenhouse gas emissions have fallen steadily over time (Figure 44). Between 1990 and 2009, energy use within the food, drink & tobacco sector fell by 28% to 3 Mtoe, compared to an increase of 7% in output and implying a total reduction in energy intensity of 35% over the period (2).

The major source of energy used was natural gas (61%) or electricity (31%). The major end use of the energy is in low temperature processes at 63% of total consumption (Figure 45). An alternative decomposition of sectoral energy use identifies boilers as being the most significant application accounting for 49% of total consumption, followed by heating at 27% (3).

Figure 46 gives a breakdown of energy consumption by food & drink sub-sector. The largest sub-sector consumption is within other foods (33%) and beverages (20%); for these sub-sectors a greater level of disaggregation has been shown.

---

Primary energy terms, i.e. including energy losses during generation and transmission as well as energy consumption

Other foods as described by SIC, which includes: Bread, pastry & cakes; sugar, cocoa, tea & coffee as well as “other food”
Figure 44: Food, drink & tobacco energy consumption (ktoe) & greenhouse gas emissions (ktCO₂e)

Sources: (2) & (4)

Figure 45: Food & drink manufacturing energy consumption by end use process, 2009 (ktoe)

Source: (2)

Figure 46: Food & drink manufacturing energy consumption by sub-sector, 2007 (ktoe)

Source: (2)
2.1.3 Distribution

Within the food supply chain, transportation is estimated to account for around 15 MtCO$_2$e of greenhouse gas emissions. Between 1992 and 2006 emissions rose significantly, although since 2006 this has declined by 8% (Figure 47). Road freight (HGVs and vans; both in the UK and overseas) account for around half of the greenhouse gas emissions from food transport (Figure 48), followed by cars (mostly consumers’ transport), and sea and air freight.

For the total road freight sector (of which ca.26% is to transport food, drink and tobacco products, as measured by million tonnes transported by domestic freight) (5), 12.7 Mtoe were consumed in 2010. Road freight energy consumption rose by 11% between 1990 and 2009, of which 5% is accounted for by increased output, implying that intensity rose by 6% over the period (6). For food transport specifically, the distance travelled by HGVs was only 4% higher in 2009 than in 1992 (7).

Despite accounting for only 0.1% of total vehicle miles, air freight produces 13% of food transport greenhouse gas emissions, and thus could be considered a ‘hotspot’. Air freight miles for food rose rapidly between 1992 and 2007, rising from 10 million km to 34 million km (equivalent to 8.5% per year growth rate), although this total has subsequently decreased to 26 million km (7).

Figure 47: Food transport greenhouse gas emissions over time (ktCO$_2$e)

Source: (7)

Figure 48: Food transport greenhouse gas emissions, 2009 (ktCO$_2$e)

Source: (7)
2.1.4 Retail

Energy consumption within the retail sector is estimated at 3.4 Mtoe for 2009, of which 77% was electricity and 21% natural gas (8). Food retail will represent a proportion of this. Lighting and heating account for the two largest shares of energy consumption (Figure 49).

Figure 49: Retail energy consumption by end use process, 2009 (Mtoe)

Source: (8)

2.1.5 Hotels & Catering

Energy consumption in the hotels & catering sector is estimated at 2.1 Mtoe for 2009, of which 51% was natural gas and 45% electricity (8). Heating and catering account for the two largest shares of energy consumption (Figure 50).

Figure 50: Hotels & catering energy consumption by end use process, 2009 (Mtoe)

Source: (8)

Trend data for energy consumption is available at an aggregate level for the commercial services sectors, and retail and hotels & catering account for approximately half of this energy consumption. The data show that between 1990 and 2009 energy consumption rose by 7%, set against a 91% increase in output (in terms of gross value added) implying an 84% reduction in energy intensity (8).
2.2 **Waste Generation & Management**

2.2.1 **Supply Chain**

It is much quoted that in the UK food supply chain an estimated **18-20 Mt** of food is wasted each year (Figure 51). Much of the waste arises at households or in agriculture (included within other), although manufacture (22%), retail (8%) and food service & restaurants (16%) do account for almost half of this total. More recent estimates have been developed for many (though not all) stages of the supply chain.

*Figure 51: Historic estimates of food waste in the food supply chain (Mt)*

The most comprehensive recent study (9) of waste in the food supply chain covered manufacturing, distribution, retail and households. Total waste was estimated at **18.5 Mt** for these stages, of which 61% was food waste and 28% was packaging; and 65% of the waste was from households, 27% by manufacturers and 8% by retail (Figure 52). For the other sector of interest – hospitality - recent estimates for 2009 put waste arising at 3.4 Mt of which 43% was mixed waste and 57% was recycled or re-used.

*Figure 52: Waste arisings in the supply of food & drink to UK household (tonnes)*

Source: (9), (10)

Source: (9) except hospitality (11)
2.2.2 Food & drink manufacture

Evidence from the food & drink sector (12) shows that waste arisings have fallen progressively over time, by 33% between 1998 and 2009, even as turnover has increased over the period (Figure 53); a trend also observed in other studies (9), (13). This puts waste arising at 5.8 Mt for 2009, the year of the latest C&I waste survey.

Animal and vegetable wastes account for half of the waste arising in 2009, with chemical waste, common sludges and mixed wastes accounting for most of the remainder (Figure 54). Much of the waste arises from larger firms, with 92% of the waste being generated by companies with more than 50 employees, and companies with 250 or more employees being responsible for 60% of the arisings (1).

In England in 2009, 8% of arisings were sent to land disposal and 24% to land recovery. Other fates include recycling (36%), composting (6%), thermal and non-thermal treatment (10%), re-use (8%) and energy recovery (2.5%) (1). A substantial proportion of the UK food & drink industry’s arisings are sold or given away free as animal feed, the material in this context being termed by the industry as ‘by-product’. In 2006 it was estimated that 2.2 Mt of arisings were diverted to animal feed (9).

Figure 53: Waste arisings in food, drink & tobacco manufacturing over time (Mt)

Source: (12)

Figure 54: Composition of waste arising in food, drink & tobacco manufacturing, 2009

Source: (1)
2.2.3 Distribution & Retail

Estimates from the 2009 C&I Waste Survey put waste arisings in the sector at 11.2 Mt, of which around 10% can be attributed to grocery retail. These latest estimates suggest that the trend of increasing waste arisings in the retail and wholesale sector has been halted and has begun a reversal, putting waste arisings in 2009 at a similar level to 1998, even as sector turnover has continued to rise (Figure 55).

The composition of waste in the sector is mainly comprised of non-metallic wastes (mostly paper, card and other packaging) and mixed waste, which account for over 80% of the waste arising in 2009 in England. (The composition of the mixed waste has been estimated at around 70% non-metallic waste, 20% metallic waste and 10% animal and vegetable waste). The data indicate that 60% of the waste originates in companies with fewer than 50 employees, and 82% in those with fewer than 250 (1).

Waste arisings for the grocery retail sector portion (including distribution) are estimated at 1.60 Mt and 1.56 Mt in 2007 and 2008 respectively (9), indicating a 2.1% decline in waste arisings between the two reported years. This implies the grocery retail sector accounts for around 10% of waste arising in the retail and wholesale sector. Within grocery retail waste, cardboard (61%) and food (24%) account for the largest proportions of waste arising (Figure 56). The economic loss associated with the food wasted by grocery retailers is put at £2.35bn.

Figure 55: Waste arisings in retail & wholesale over time (Mt)

![Waste arisings in retail & wholesale over time (Mt)](source: 1)

Figure 56: Composition of waste arising in food distribution & retail

![Composition of waste arising in food distribution & retail](source: 9)
2.2.4 Hotels & Catering

After a period of relative stability, waste arisings from the UK hospitality sector have declined (Figure 57). Data from the 2009 C&I waste survey indicate annual arisings of around 3.3 Mt from sector. As expected, given the diverse and fragmented nature of the hospitality sector, much of the industry’s waste arises from smaller firms: 2009 data from Defra indicate that 85% of hospitality waste in England is generated by businesses with fewer than 50 employees. Compositional data from the 2009 C&I waste survey indicated that nearly 90% of the waste was non-metallic waste (39%), i.e. packaging, or mixed waste (50%). Much of the mixed waste was indicated as being non-metallic waste (68%) or animal or vegetable waste (24%).

The results of recent compositional analysis of hospitality waste have shed further light on the types of waste being sent to disposal from hotels, pubs, quick service restaurants (QSRs) and restaurants. Of the 3.4 Mt estimated arising, 47% was destined for re-use or recycling, 43% was mixed waste destined for disposal and 10% was managed through other routes (Figure 58). The study highlighted that much of the mixed waste currently destined for disposal is kitchen or dry recyclables that could be cost effectively managed through other routes.

Figure 57: Waste arisings in hotels & catering over time (Mt)

![Graph showing waste arisings in hotels & catering over time (Mt)](Graph1.jpg)

Source: (15)

Figure 58: Composition of waste arising in hospitality, 2009

![Pie chart showing composition of waste arising in hospitality, 2009](Graph2.jpg)

Source: (11)
2.3 Water Consumption

The WWF estimated in 2008 that the UK’s total water footprint was 102 billion cubic metres of water per year or equivalent to 4,645 litres per person per day. Nearly three quarters of the total water footprint was that embedded in agricultural products – crops and livestock (Figure 59) – and it is noted that 62% of the total water footprint originated from outside the UK (16).

*Figure 59: Estimated water footprint of the UK (billion m³ per year)*

A recent report by WRAP aimed to identify the water hotspots for UK grocery products. The research estimated the water footprints of 70 food and drink products. Table 14 shows the 10 products that contribute the most to total water footprint. It is informative to note that these products represented only a third of total UK sales, but accounted for 71% of the total water footprint. However with the exceptions of milk & cream and meat, the majority of the water footprint originates outside the UK. Where products are sourced from both the UK and overseas it is possible to compare the relative water efficiency of UK producers, which is generally favourable (Figure 60). The study also investigated the proportion of the water footprint from green (rainfall) and blue (groundwater) sources.

*Table 14: Top 10 water footprint hotspot products*

<table>
<thead>
<tr>
<th>Product</th>
<th>UK sales, 2010 (kt)</th>
<th>% of total UK sales</th>
<th>% of UK sales imported</th>
<th>Water footprint (billion litres)</th>
<th>% of total water footprint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chocolate</td>
<td>589</td>
<td>2%</td>
<td>100%</td>
<td>15.6</td>
<td>31%</td>
</tr>
<tr>
<td>Concentrated juice</td>
<td>707</td>
<td>2%</td>
<td>100%</td>
<td>5.1</td>
<td>10%</td>
</tr>
<tr>
<td>Milk &amp; cream</td>
<td>5,443</td>
<td>16%</td>
<td>1%</td>
<td>4.1</td>
<td>8%</td>
</tr>
<tr>
<td>Beef</td>
<td>291</td>
<td>1%</td>
<td>18%</td>
<td>2.8</td>
<td>6%</td>
</tr>
<tr>
<td>Coffee - instant</td>
<td>43</td>
<td>0%</td>
<td>100%</td>
<td>1.9</td>
<td>4%</td>
</tr>
<tr>
<td>Bread &amp; rolls</td>
<td>2,769</td>
<td>8%</td>
<td>11%</td>
<td>1.7</td>
<td>3%</td>
</tr>
<tr>
<td>Frozen Meat Products</td>
<td>167</td>
<td>0%</td>
<td>18%</td>
<td>1.6</td>
<td>3%</td>
</tr>
<tr>
<td>Tea</td>
<td>80</td>
<td>0%</td>
<td>100%</td>
<td>1.1</td>
<td>2%</td>
</tr>
<tr>
<td>Juices</td>
<td>1,481</td>
<td>4%</td>
<td>100%</td>
<td>1.1</td>
<td>2%</td>
</tr>
<tr>
<td>Poultry</td>
<td>435</td>
<td>1%</td>
<td>23%</td>
<td>1.1</td>
<td>2%</td>
</tr>
<tr>
<td>Others</td>
<td>21,722</td>
<td>66%</td>
<td>-</td>
<td>13.9</td>
<td>29%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>33,727</strong></td>
<td><strong>100%</strong></td>
<td><strong>-</strong></td>
<td><strong>50.0</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

*Source: (18)*
One of the initial aims of the WRAP study was to identify the relative proportions of the water footprint attributable to each stage of the supply chain. However, with a few exceptions the study was unable to identify such data. The exceptions included cereal, carbonated drinks, orange juice and coffee. For each of these examples, manufacture of the product accounted for less than 1% of the total water footprint. The vast majority of the water footprint was from the production of the raw ingredients, although the manufacture of the packaging was important for some products. Similar findings are seen in the water footprint analysis undertaken by Unilever for tea and margarine (19).

In terms of UK direct water consumption in the food supply chain, the much quoted (if now somewhat out of date) 2001 estimates of water consumption are shown in Figure 61. Total consumption is estimated at 1,227 million m$^3$ of water. Agriculture accounted for 61% of the total, followed by food & drink manufacturing and hotels & restaurants. Disaggregated water consumption was estimated for the sub-sectors of food & drink manufacturing: Dairies, breweries, soft drinks, distilleries and meat accounted for nearly half of the water consumption in the food & drink sector. Wastewater discharges from the food & drink sector were estimated at 294.7 million m$^3$ in 2004 (based on water consumption of 362.6 million m$^3$ and estimated water loss during baking etc. or within biodegradable waste) (20).
2.4 **Emissions to Air**

For emissions to air (other than carbon emissions), data are available for the food & drink manufacturing and food transport sectors.

Acid rain precursor emissions from food & drink manufacturing have steadily fallen over the last 15 years, from around 100 ktSO$_2$e in the early 1990s to their current level of just over 20 ktSO$_2$e for 2008 (**Figure 62**). This represents a fall of around 75%. It is noticeable that the greatest reductions have been achieved for emissions of sulphur dioxide.

**Figure 62: Trends in acid rain precursor emissions from food & drink manufacturing (ktSO$_2$e)**

![Graph showing trends in acid rain precursor emissions from food & drink manufacturing](source)

Emissions to air from food transport have also fallen steadily over the same period, from around 200 kt to a current level of 140 kt, or a decline of around a third in total (**Figure 63**). The largest reductions in emissions have been achieved in particulate matter and nitrogen oxides.

**Figure 63: Emissions to air from food transport over time (kt)**

![Graph showing emissions to air from food transport](source)
2.5 **Improvement Potential**

2.5.1 **Overview**

The previous sections summarised the resource usage in the food & drink supply chain. It is illustrative to highlight the potential savings that are estimated to be available to businesses as result of greater resource efficiency, although it should be noted that resource efficiency and ‘Lean’ thinking are not necessarily equivalent. Resource efficiency opportunities within the food & drink supply chain are estimated at £1,257m in 2009, of which distribution and manufacturing account for 57% and 27% respectively of the estimated savings opportunity (Figure 64). The carbon impact is estimated at 3.6 MtCO$_2$e. The following subsections outline the nature of the major saving opportunities.

![Figure 64: Estimated no cost / low cost resource efficiency opportunities in 2009 (£m)](image)

*Food distribution has been assumed to represent 26% of total freight opportunity and food retail 12% of total retail opportunity Source: Adapted from (22)*

2.5.2 **Food & Drink Manufacture**

Within food & drink manufacture, waste accounts for the majority of the savings opportunity. The major causes of avoidable waste are given in Table 15 and include management, process, product, environmental and consumer factors, which Lean thinking can be used to mitigate. As for water use the Federation House report potential savings of 12.5% being achievable through technical support for its signatories. Current progress reveals a reduction of 6.6% in total water use between 2007 and 2010 (23).

*Table 15: Causes of avoidable waste in the food & drink sector*

<table>
<thead>
<tr>
<th>Type of factor</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management factors</td>
<td>Decision making errors</td>
</tr>
<tr>
<td></td>
<td>Information sharing</td>
</tr>
<tr>
<td></td>
<td>Shelf life policies</td>
</tr>
<tr>
<td></td>
<td>Inventory management</td>
</tr>
<tr>
<td></td>
<td>Stacking and shelving</td>
</tr>
<tr>
<td></td>
<td>Penalties and availability targets</td>
</tr>
<tr>
<td></td>
<td>Lack of employee training &amp; awareness</td>
</tr>
<tr>
<td></td>
<td>Corporate liquidations</td>
</tr>
<tr>
<td>Process factors</td>
<td>Overfills or short fills</td>
</tr>
<tr>
<td></td>
<td>Operator error</td>
</tr>
<tr>
<td></td>
<td>Poor quality production</td>
</tr>
<tr>
<td></td>
<td>Preparation waste</td>
</tr>
<tr>
<td></td>
<td>Inefficient dispensing of supplies waste</td>
</tr>
<tr>
<td></td>
<td>Over-ordering</td>
</tr>
<tr>
<td></td>
<td>Line spillages</td>
</tr>
<tr>
<td></td>
<td>Changeover or clean down waste</td>
</tr>
<tr>
<td>Product factors</td>
<td>Product characteristics</td>
</tr>
<tr>
<td></td>
<td>Over or under packaging</td>
</tr>
<tr>
<td></td>
<td>Product damage, product recalls</td>
</tr>
<tr>
<td></td>
<td>Poor conformity</td>
</tr>
<tr>
<td></td>
<td>New product development</td>
</tr>
<tr>
<td></td>
<td>Dropped products</td>
</tr>
<tr>
<td>Environmental and</td>
<td>Customer trends</td>
</tr>
<tr>
<td>Consumer factors</td>
<td>Weather and seasonality</td>
</tr>
<tr>
<td></td>
<td>Catastrophic failures</td>
</tr>
<tr>
<td></td>
<td>Cancelled promotions</td>
</tr>
<tr>
<td></td>
<td>Last-minute customer order cancellations</td>
</tr>
</tbody>
</table>

*Source: (12)*
2.5.3 Distribution

For distribution it was estimated that significant reductions in fuel consumption could be achieved through greater resource efficiency for both HGVs and LGVs and for public and own account vehicles. Examples of cost effective interventions are listed in Table 16. It is noted that significant savings can also be achieved through driver training; however greater behavioural barriers exists for this, and the persistence of the savings can often be relatively low.

Table 16: Examples of low cost resource efficiency interventions in the freight sector

<table>
<thead>
<tr>
<th>Action</th>
<th>Main impact</th>
<th>Economic saving</th>
<th>CO₂ reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater capacity vehicles</td>
<td>Fewer miles</td>
<td>5.3%</td>
<td>6.5%</td>
</tr>
<tr>
<td>Out of hours deliveries</td>
<td>Friendlier miles</td>
<td>2.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Engine specifications</td>
<td>Friendlier miles</td>
<td>3.5%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Vehicle telematics / CVRS</td>
<td>Fewer miles</td>
<td>3.0%</td>
<td>2.3%</td>
</tr>
<tr>
<td>Transport collaboration</td>
<td>Fewer miles</td>
<td>3.2%</td>
<td>3.8%</td>
</tr>
<tr>
<td>Logistics systems redesign</td>
<td>Fewer miles</td>
<td>2.3%</td>
<td>2.8%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Both</strong></td>
<td><strong>17.3%</strong></td>
<td><strong>14.2%</strong></td>
</tr>
</tbody>
</table>

Source: (24); ‘Friendlier’ means lower impact per mile.

2.5.4 Retail, Hotels & Catering

In retail, hotels & catering, energy represents the greatest saving opportunity. Data from The Carbon Trust’s energy efficiency audits in 2006/07 highlight the nature of the opportunity (Figure 65). The audits identified carbon & energy management and building energy efficiency measures as representing the greatest opportunities. Implementation rates are estimated to be relatively high in the retail sector at 55%, and are higher for large companies even though energy represents a very small percentage of company turnover (0.1%-1%). In contrast, the services sector has a lower implementation rate of 31%. The majority of the opportunities identified had a payback period of less than two years.

Figure 65: Carbon Trust identified recommendations to services & retail sectors by technology (2006/07)
3 An Analysis of Hotspots in the Food Supply Chain

3.1 Overview

As an introduction to the analysis of hotspots it is useful to provide an overview of the relative magnitude of hotspots between the categories. Recent research by WRAP (26) has estimated the relative greenhouse gas (GHG) emissions associated with the retail supply chain (excludes consumer use and hospitality) with the aim of identifying hotspots. This estimated total emissions associated with food & drink at 67 MtCO$_2$e (Figure 66). Three food categories – dairy, ambient and meat & poultry – accounted for two thirds of the estimated GHG emissions (Figure 67).

No comparable data have been identified for other environmental impacts across the supply chain e.g. waste and water, although the following sections summarise the available hotspots data for each category. However it should be that each of the resource maps had slightly different terms of reference with respect to the evidence to be collated. A separate section has been included for hospitality as it is generally being omitted from the supply chain hotspots data, and to reflect the different nature of the opportunity associated with the sector.

Figure 66: Retail supply chain food & drink GHG emissions by category, excluding consumer use (MtCO$_2$e)

Source: (26)

Figure 67: Retail supply chain food & drink GHG emissions by category, excluding consumer use (MtCO$_2$e)

Source: (26)
3.2 Meat & Poultry

Expenditure for products in the meat and poultry sector is greater than any other category of food, with over £16bn spent and just less than 5 Mt consumed annually, largely split between four animal products: poultry (36%), pork (30%), beef (25%) and lamb (9%) (27).

The agricultural production stage is the key hotspot in terms of GHG emissions, which are highly variable due to the methane emissions associated with different livestock (Figure 68). During the manufacturing stage 454 ktCO₂e are generated per year, 65% of which arises from mechanically intensive poultry processing. Further hotspots for GHG emissions are the transportation stage, refrigeration (leakages and display cabinet refrigeration) and rendering. Rendering generates net emissions of 1.31 MtCO₂e per year whilst also producing useful products.

Figure 68: GHG emissions of retail meat products

![GHG emissions of retail meat products](source)

1.4 Mt of waste is estimated to arise annually from the fresh meat retail supply chain, of which 97% derives from abattoirs and cutting plants. Packaging waste arising in the meat and poultry industry is also high, with approximately 110 kt of packaging disposed of per year, 73% of which is to landfill. In addition, waste at the retail stage is also high, with approximately 72 kt of fresh meat disposed of annually (Figure 69).

Figure 69: Estimated total waste in UK of retail meat products (kt)

![Estimated total waste in UK of retail meat products](source)

The manufacturing stage of the fresh meat supply chain is the most water intensive, using approximately 12 million m³ of water annually for slaughtering and cutting. Although EU regulations outline strict hygiene requirements, it is estimated that approximately 80,000 m³ of water and £250,000 could be saved per year through introducing better on-site wastewater treatment.
3.3 **Fish & Seafood**

In the UK, 818 kt of seafood are consumed annually, with GHG emissions ranging from 0.96 tCO₂e/tonne to 13.4 tCO₂e/tonne depending on the species (Figure 70). The key hotspots in the fish and shellfish supply chain are dependent on the method of capture, transportation to retail and the extent of processing. The total volume of waste and co-products arising in the fresh fish and seafood supply chain is estimated at 140 kt per year, 94% of which arises during the processing and production stage and 6% in retail. The fish and seafood supply chain is highly water-intensive: thawing, washing and filleting production processes all require significant water use. The breakdown of water usage (m³/tonne) by species can be seen in Table 17.

**Figure 70: GHG emissions of selected product chains**

![GHG emissions of selected product chains](image)

**Source:** (28)

**Figure 71: Comparison of total waste and co-products by species category**

![Comparison of total waste and co-products by species category](image)

**Source:** (28)

**Table 17: Water usage (m³/tonne) for various seafood species**

<table>
<thead>
<tr>
<th>Species</th>
<th>Process/Product</th>
<th>Water usage (m³/tonne)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marine finfish</td>
<td>Conventional Plant</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Mechanised Plant</td>
<td>14</td>
</tr>
<tr>
<td>Shrimp</td>
<td>Frozen Product</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>Breaded Product</td>
<td>116</td>
</tr>
<tr>
<td>Salmon</td>
<td>Conventional Plant</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>Mechanised Plant</td>
<td>19.20</td>
</tr>
<tr>
<td>Mussel</td>
<td></td>
<td>20-120</td>
</tr>
</tbody>
</table>

**Source:** (28)
3.4 **Fruit & Vegetables**

The fruit & vegetables sector (including potatoes) is estimated to account for 2.5% of the UK’s overall GHG emissions and 10-12.5% of total food-related emissions (29). Three key hotspots for emissions have been identified in the fruit & vegetables supply chain (Table 18):

<table>
<thead>
<tr>
<th>Stage in supply chain</th>
<th>Source of GHG emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural production</td>
<td>Product variety, growing medium and agronomic management</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>Cold storage, transport</td>
</tr>
<tr>
<td>Transport</td>
<td>Air freight, road and sea transport</td>
</tr>
</tbody>
</table>

Table 18: Hotspots for emissions in the fruit & vegetables supply chain

The overall waste arising in the fruit & vegetable supply chain is estimated to be 2.23-2.48 Mt, which can equate to a loss of product up 30-50% over the entire supply chain (30). Table 19 provides a number of specific examples (11 product categories), providing estimates of losses at each stage in the fruit and vegetable supply chain. This data highlights certain hotspots such as grading (apple, onion, and avocado) and packing (potato). Of the waste arising from the fruit & vegetables supply chain, 1-4% occurs at the retail sector. Although in terms of the total waste resulting from the supply chain the role of retailers seems minimal, fruit & vegetables waste accounts for 25% of all food waste in retail and therefore presents an opportunity for waste prevention and diversion.

Table 19: Estimated losses in the UK fruit and vegetable supply chain (%)

<table>
<thead>
<tr>
<th>Product</th>
<th>Field loss</th>
<th>Grading loss</th>
<th>Storage loss</th>
<th>Packing loss</th>
<th>Retail waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strawberry</td>
<td>2-3%</td>
<td>1%</td>
<td>0.50%</td>
<td>2-3%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Raspberry</td>
<td>2%</td>
<td>No data</td>
<td>No data</td>
<td>2.3%</td>
<td>2.3%</td>
</tr>
<tr>
<td>Lettuce</td>
<td>5-10%</td>
<td>No data</td>
<td>No data</td>
<td>0.5-2%</td>
<td>1%</td>
</tr>
<tr>
<td>Tomato</td>
<td>5%</td>
<td>7%</td>
<td>No data</td>
<td>3.5-5%</td>
<td>2.5-3%</td>
</tr>
<tr>
<td>Apple</td>
<td>5-25%</td>
<td>5-25%</td>
<td>3.4%</td>
<td>3.8%</td>
<td>2.3%</td>
</tr>
<tr>
<td>Onion</td>
<td>3-5%</td>
<td>9-20%</td>
<td>3-10%</td>
<td>2.3%</td>
<td>0.5-1%</td>
</tr>
<tr>
<td>Potato</td>
<td>1-2%</td>
<td>3-13%</td>
<td>3-5%</td>
<td>20-25%</td>
<td>1.5-3%</td>
</tr>
<tr>
<td>Broccoli</td>
<td>10%</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>1.5-3%</td>
</tr>
<tr>
<td>Avocado</td>
<td>No data</td>
<td>30%</td>
<td>5%</td>
<td>3%</td>
<td>2.5-5%</td>
</tr>
<tr>
<td>Citrus</td>
<td>No data</td>
<td>3%</td>
<td>No data</td>
<td>0.1-0.5%</td>
<td>2-2.5%</td>
</tr>
<tr>
<td>Banana</td>
<td>No data</td>
<td>3%</td>
<td>No data</td>
<td>0-3%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Table 20: Water usage in fruit & vegetables processing sector

<table>
<thead>
<tr>
<th>Sector</th>
<th>Water use millions m³ per tonne of product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit juices</td>
<td>6.5</td>
</tr>
<tr>
<td>Baby food</td>
<td>6 - 9</td>
</tr>
<tr>
<td>Jams</td>
<td>6</td>
</tr>
<tr>
<td>Frozen vegetables</td>
<td>5 - 8.5</td>
</tr>
<tr>
<td>Canned vegetables</td>
<td>3.5 - 6</td>
</tr>
</tbody>
</table>

Some data is also available in the water usage for the processing of selected fruit and vegetable products (Table 20), however clearly there are limitations and gaps in this evidence. Water use was not considered within the resource map commissioned by WRAP.

Table 20: Water usage in fruit & vegetables processing sector

Source: (29)

Source: (31)
3.5 **Dairy**

In the UK, over 13 billion litres of milk are produced, of which around half is processed into milk products, i.e. cheese (27%), milk powders (10%) and other products such as butter, cream and yoghurt (ID267). The GHG emissions for liquid milk are estimated at 1.18 kgCO₂e per litre of milk, of which the major impact (85%) is during raw milk production (Figure 72), with packaging, milk processing and transport accounting for most of the remainder. This equates to around 15.5 Mt of greenhouse gas emissions from liquid milk production.

*Figure 72: Greenhouse gas impacts of liquid milk within the supply chain (kgCO₂e)*

![Chart showing greenhouse gas impacts of liquid milk](image)

Source: (32)

*Figure 73: Milk losses within the supply chain (per litre of milk consumed)*

![Chart showing milk losses](image)

Source: (32)

It has been estimated that for every litre of milk consumed 1.3 litres needs to be produced, equating to losses of around 23% in the supply chain (*Figure 73*). The greatest losses occur within households (0.18 litres) and in dairy processing (0.08 litres). Water use has been estimated at around 9 litres in the supply chain, around 8 litres of which is during raw milk production and 1 litre within dairy processing.  *Table 21* shows the variation of water consumption between different types of dairy processing sites.

*Table 21: Water consumption at dairy processing sites (m³/tonne)*

<table>
<thead>
<tr>
<th>Year</th>
<th>Industry</th>
<th>Liquid milk</th>
<th>Cheese</th>
<th>Mixed dairy</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>1.18</td>
<td>1.03</td>
<td>1.25</td>
<td>1.54</td>
</tr>
<tr>
<td>2010</td>
<td>1.29</td>
<td>0.86</td>
<td>1.15</td>
<td>2.36</td>
</tr>
</tbody>
</table>

Source: (33)
3.6 Bakery

An estimated 2.77 Mt of bread and rolls are consumed each year in the UK, as well as a further 0.85 Mt of morning goods and cakes & pastries (26). Relatively little hotspots data were identified for bakery products, which has not been the focus of a detailed study to map resource use in its supply chain.

Hotspot data for greenhouse gas emissions only have been identified for the bakery category. The carbon footprint of an 800g loaf of bread was estimated at 1.1-1.2 kgCO₂e. The greatest life cycle impacts were estimated for wheat production, and toasting and chilling in the use phase (Figure 74). Manufacturing accounted for around 16% of the total footprint. The Carbon Trust estimated that baking accounted for 35-45% of CO₂ emissions from the industrial baking process (Figure 75).

![Figure 74: Contribution of life cycle stages to total carbon footprint of bread](image)

Source: (26)

![Figure 75: Breakdown of CO₂ emissions from industrial bakery processes (min-max range)](image)

Source: (34)
3.7 **Pre-prepared Foods**

The pre-prepared foods category encompasses products from all previous categories, as well as ready meals and processed ready to eat foods. Chilled foods were previously identified by EMDA as a hotspot for waste to landfill and effluent costs (35).

A resource map of five different pre-prepared chilled and frozen products has recently (2012) been completed by WRAP. *Figure 76* gives the example of the automated manufacture of chicken salad sandwiches, showing the losses of each of the ingredients. Some of these losses are unavoidable. The overall results of the resource map are shown in *Table 22*, which gives the product losses associated in manufacture and retail for each of the five products. Losses in retail are generally between 3% and 6%; however, product losses associated with manufacture are generally higher and can exceed 100 products per 1,000 distributed. Benchmark water usage data is also provided for manufacture.

Data on GHG emissions identifies the raw materials (i.e. agricultural production) as a key hotspot within the chilled & frozen supply chain, particularly when meat content is high (*Figure 77*). The distribution and retail stages are also hotspots, due to the use of refrigeration equipment.

*Figure 76: Ingredient losses in the automated manufacture of 1,000 chicken salad sandwiches (kg)*

*Table 22: Product losses and water usage for pre-prepared food products*

<table>
<thead>
<tr>
<th>Product</th>
<th>Losses (per 1,000 distributed)</th>
<th>Water usage (m³/t product)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Manufacture</td>
<td>Retail</td>
</tr>
<tr>
<td>Tuna and sweet-corn sandwich</td>
<td>45</td>
<td>44</td>
</tr>
<tr>
<td>Chicken salad sandwich</td>
<td>63-155</td>
<td>64</td>
</tr>
<tr>
<td>Beef lasagne al forno</td>
<td>21</td>
<td>37</td>
</tr>
<tr>
<td>Hot eating beef pie</td>
<td>90-176</td>
<td>30</td>
</tr>
<tr>
<td>Cheese and tomato pizza</td>
<td>84-138</td>
<td>29</td>
</tr>
</tbody>
</table>

*Source: (36)*

*Figure 77: Impact of the life cycle stages on the carbon footprint of a cottage pie ready meal*

*Source: (26)*
3.8 Ambient Products

The ambient category contains those products which are not included elsewhere and are characterised as requiring energy impacts at the consumer stage (e.g. tea, coffee, pasta). Relatively little hotspots data were identified for ambient products, which has not been the focus of a detailed study to map resource use in its supply chain. Research into this product category is predominantly focused on the carbon impact of operations.

Within the ambient product supply chain, the production stage is identified as the major hotspot contributing to GHG emissions (Figure 78 and 79), with the use phase also a large contributor depending on the cooking times and heating methods adopted (26). For canned and bottled products, in addition to the impact of raw materials, packaging and manufacturing GHG impacts are significant (Figure 79).

Figure 78: Life cycle GHG emissions of Italian durum dried pasta, Danish macaroni and Japanese rice

![Figure 78](image1.png)

Source: (26)

Figure 79: Life cycle GHG emissions of canned fish, beans and soup

![Figure 79](image2.png)

Source: (26)
### 3.9 Drinks

For drinks, the greenhouse gas impacts are spread between different stages across the life cycle. While ingredients are an important hotspot, so are packaging, manufacture and distribution and retail (Figure 80). For soft drinks, such as Coca-Cola and water, refrigeration and packaging account for the majority of the life cycle (37) (ID 290).

**Figure 80: Life cycle greenhouse gas emissions for common alcoholic beverages**

Waste in the drinks supply chain is estimated to amount to 1.5 Mt of organics arisings and 169 kt of packaging waste. Raw ingredient yield losses for drinks vary according to their type, but typical yield losses are 2-7%. Alcoholic drinks such as wine, gin and vodka typically have yield losses near 2%, the majority of which is from filtration and residues. For soft drinks where the cost of ingredients is lower, losses can be near 7% and include product giveaway, set-up and run-down losses. Packaging hotspots include stretch-wrap, where it is estimated that 4,000 tonnes could be saved through best practice.

From evaluating the range water intensities of different drinks categories, significant variation was noted, identifying that considerable reductions in water consumption are possible. The analysis shows that a 10% move in average practice towards the minimum or best practice would result in an estimated annual saving of 2.2 billion litres of water, a financial saving of £2.2m and an environmental saving of 2.25 ktCO₂e (Table 23). Further analysis of the beer category revealed that best practice is not simply a scale issue, since many of the better performing companies are micro-breweries.

**Table 23: Analysis of annual water consumption in the UK drinks sector by water intensity**

<table>
<thead>
<tr>
<th>Drinks category</th>
<th>Range of water intensities</th>
<th>Volume of product (M litres)</th>
<th>Volume of water used (M litres)</th>
<th>10% savings opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ave</td>
<td>Min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beer</td>
<td>4.43</td>
<td>2.96</td>
<td>4,500</td>
<td>19,935</td>
</tr>
<tr>
<td>Wine</td>
<td>3.29</td>
<td>1.46</td>
<td>214</td>
<td>704</td>
</tr>
<tr>
<td>Fruit Juice</td>
<td>3.5</td>
<td>0.5</td>
<td>811</td>
<td>2,839</td>
</tr>
<tr>
<td>Carbonates &amp; dilutables</td>
<td>2.3</td>
<td>1.4</td>
<td>4,410</td>
<td>10,143</td>
</tr>
<tr>
<td>Juice drinks</td>
<td>2.3</td>
<td>1.4</td>
<td>436</td>
<td>1,003</td>
</tr>
<tr>
<td>Distilleries</td>
<td>21.3</td>
<td>7.72</td>
<td>572</td>
<td>12,184</td>
</tr>
<tr>
<td>Cider</td>
<td>3.36</td>
<td>2.38</td>
<td>960</td>
<td>3,226</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11,903</strong></td>
<td><strong>50,033</strong></td>
<td><strong>2,251</strong></td>
<td><strong>6.98</strong></td>
</tr>
</tbody>
</table>

*Source: (38)*
### 3.10 Hospitality

The recent hospitality waste composition study identified that, of the 1.5 Mt of waste currently disposed of to landfill, 77% is recyclable through existing waste management routes (11). Considerable opportunities also exist for food waste prevention. A survey of food waste in restaurants identified that on average 0.48 kg of food waste was generated per restaurant diner (39). Of this waste around two thirds was preparation waste, with customer plate waste comprising 30% (Figure 81). Various recommendations were made on options to reduce this food waste (Table 24).

A study of hospitality water use in Crawley identified considerable water savings (5,065 m³ per year) for pubs, clubs and restaurants. The majority of these savings were in improved urinal controls (Figure 82).

**Figure 81: Types of food waste in restaurants**

![Chart showing the distribution of food waste in restaurants with 4.7% spoilage, 65.7% preparation, and 29.6% customer plate.]

**Source:** (39)

**Table 24: Options for preventing food waste in restaurants**

<table>
<thead>
<tr>
<th>Source</th>
<th>Recommendations</th>
<th>Source</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td>9 Carry out survey of food waste to measure and benchmark waste</td>
<td><strong>Preparation</strong></td>
<td>12 Careful ordering and menu planning</td>
</tr>
<tr>
<td></td>
<td>10 Reduce waste at source</td>
<td></td>
<td>13 Work with suppliers</td>
</tr>
<tr>
<td></td>
<td>11 Engage staff on the issue</td>
<td></td>
<td>14 Keep skins on vegetables where acceptable to diner (e.g. potato skins)</td>
</tr>
<tr>
<td><strong>Customer plate</strong></td>
<td>18 Careful consideration of portion sizes or offer different portion sizes</td>
<td></td>
<td>15 Re-use edible food items that often get thrown out (e.g. orange peel for making marmalade)</td>
</tr>
<tr>
<td></td>
<td>19 Offer doggy bags where appropriate</td>
<td></td>
<td>16 Order fish and meat cuts to specification, keeping off-cuts with producers that can dispose of them more cheaply</td>
</tr>
<tr>
<td></td>
<td>20 Menu planning to ensure food meets customers’ seasonal expectations</td>
<td></td>
<td>17 Employ nose-to-tail cooking methods (i.e. use more of the animal)</td>
</tr>
<tr>
<td></td>
<td>21 Observe customer eating to identify &amp; eliminate often-wasted items</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Spoilage</strong></td>
<td>22 Careful ordering</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>23 Check fridge temperatures regularly</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>24 Diligence with labelling and storage</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Adapted from (39)

**Figure 82: Water savings in the Crawley hospitality project**

![Pie chart showing water savings with 5% fixed leaks, 22% flow rate adjustments, 23% save-a-flush bags, and 50% urinal controls.]

**Source:** (40)
## 4 Summary of Hotspots Analysis

The following table summarises the hotspot analysis presented within this report by food category and sector:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Meat &amp; poultry</th>
<th>Fish &amp; seafood</th>
<th>Fruit &amp; vegetables</th>
<th>Dairy</th>
<th>Bakery</th>
<th>Pre-prepared</th>
<th>Ambient</th>
<th>Drinks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging</td>
<td>Ruminant (E)</td>
<td>Non-ruminant (E)</td>
<td></td>
<td>Dairy (GE)</td>
<td></td>
<td>To-cook (GER)</td>
<td>Cereals (GER)</td>
<td>Can/bottle (GER)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Beer (GER)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Low-fruits (W)</td>
</tr>
<tr>
<td>Manufacture</td>
<td>Ruminant (E)</td>
<td>Non-ruminant (E)</td>
<td>Fish &amp; seafood (GER)</td>
<td>Dairy (GEWL)</td>
<td>Industrial (GE)</td>
<td>To-cook (GER)</td>
<td>Cereals (GER)</td>
<td>Can/bottle (GER)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Beer (GEWR)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wine (ER)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Spirits (GER)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fruit (GEWR)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Low-fruits (W)</td>
</tr>
<tr>
<td>Distribution</td>
<td>Ruminant (E)</td>
<td>Non-ruminant (E)</td>
<td>Fish &amp; seafood (GER)</td>
<td>Cooked (GE) Raw (GE)</td>
<td>Retail (GE)</td>
<td>To-cook (GER) Ready to eat (GER)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retail</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fuel (GE)</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lighting &amp; heating (GE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cardboard &amp; food (WR)</td>
</tr>
<tr>
<td>Hospitality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Heating (GE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Catering (GE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Food: prep &amp; plate (WR)</td>
</tr>
</tbody>
</table>

Key: GHG = G  Energy = E  Waste = W  Resource = R  Water = L

These are where the greatest impacts have been assessed. However, this does not necessarily mean that is where the greatest opportunities lie. For example, GHG emissions are different for waste in that energy is a fundamental driver, hence GHG emissions – based on a fossil fuel source – are inevitable and there will be a floor based on thermodynamic efficiency. In contrast waste is – in principle – completely avoidable.

The above table has been used as a guide, but not prescriptively, for the reviewers to target examples of corresponding activity.
Bibliography


37. **Coca-Cola.** *Our commitment to making a positive difference in the world.* London : Coca-Cola, 2010. id 212.


Note: The id numbers at the end of the bibliographic references refer to the source file id number stored at [www.infinifile.org.uk](http://www.infinifile.org.uk). You can access these sources for free, using project id 270 in conjunction with the file id when prompted. Requires registration. The adjacent QR code will take you to the site if you have the smart-phone QR reader app (many are free).
Appendix 4 – The Hospitality and Foodservice Sector
FO0425 – Lean Thinking in the Food Chain
Phase 1 Report: review of activities
– food service

A report for
Defra

August 2012
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Glossary

<table>
<thead>
<tr>
<th>SS</th>
<th>Lean technique</th>
<th>NPI</th>
<th>New product introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMR</td>
<td>Automatic meter reading</td>
<td>OoS</td>
<td>Out of specification</td>
</tr>
<tr>
<td>BRE</td>
<td>bre, formerly Building Research Establishment</td>
<td>POS</td>
<td>Point of sale</td>
</tr>
<tr>
<td>CC2</td>
<td>Courtauld Commitment Phase 2</td>
<td>QSR</td>
<td>Quick service restaurant</td>
</tr>
<tr>
<td>CO₂e</td>
<td>GHG emissions stated as equivalent tonnes of carbon dioxide</td>
<td>RDC</td>
<td>Regional distribution centre (also DC)</td>
</tr>
<tr>
<td>CRC</td>
<td>UK’s Carbon Reduction Commitment</td>
<td>RFID</td>
<td>Radio frequency identification device</td>
</tr>
<tr>
<td>CSR</td>
<td>Corporate Social Responsibility</td>
<td>RSPCA</td>
<td>Royal Society for the Prevention of Cruelty to Animals</td>
</tr>
<tr>
<td>DECC</td>
<td>Department for Energy &amp; Climate Change</td>
<td>RTP</td>
<td>Returnable transit packaging</td>
</tr>
<tr>
<td>DMAIC</td>
<td>‘Define, Measure, Analyse, Improve and Control’ improvement philosophy</td>
<td>SDDG</td>
<td>Sainsbury’s Dairy Development Group</td>
</tr>
<tr>
<td>FCC</td>
<td>Food Chain Centre</td>
<td>SJIC</td>
<td>Standard Industrial Classification (code)</td>
</tr>
<tr>
<td>FHC</td>
<td>Federation House Commitment</td>
<td>SME</td>
<td>Small-Medium Enterprise (EU definition)</td>
</tr>
<tr>
<td>FMG</td>
<td>Fast moving goods</td>
<td>SMED</td>
<td>Single minute exchange of dies – Lean technique</td>
</tr>
<tr>
<td>FVCA</td>
<td>Food value chain analysis</td>
<td>SMG</td>
<td>Slow moving goods</td>
</tr>
<tr>
<td>HACCP</td>
<td>Hazard Analysis Critical Control Point</td>
<td>SVN</td>
<td>Sustainable value network</td>
</tr>
<tr>
<td>IGD</td>
<td>The Institute of Grocery Distribution</td>
<td>tpa</td>
<td>Tonnes per annum</td>
</tr>
<tr>
<td>KPI</td>
<td>Key process indicator (of performance)</td>
<td>VA</td>
<td>Voluntary agreement</td>
</tr>
<tr>
<td>MSC</td>
<td>Marine Stewardship Council</td>
<td>VSM</td>
<td>Value stream mapping</td>
</tr>
<tr>
<td>NFU</td>
<td>National Farmers’ Union</td>
<td>WRAP</td>
<td>Waste &amp; Resources Action Programme</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-governmental organisation</td>
<td>WWF</td>
<td>Worldwide Fund for Nature</td>
</tr>
</tbody>
</table>

Units Conventional SI units and prefixes used throughout: \( (k, \text{kilo, } 1,000) \) \( (M, \text{mega, } 1,000,000) \) \( (G, \text{giga, } 10^9) \) \( (\text{kg, kilogramme, unit mass} \) \( (t, \text{metric tonne, } 1,000 \text{ kg}) \)

Context of this Report

This report is one module of the Phase 1 report of the FO0425 project, FO0425-Phase1-Report. It deals specifically with activities occurring within the food service operations of the sector. Conclusions of the report have been abstracted into the Phase 1 Report but readers should read this module for full details of the evidence review.

There are three other accompanying report modules similarly treated. These are:

- FO0425-P1-Hotspots : resource & waste hotspot identification – Section 4
- FO0425-P1-Manuf-Fill : review of sector activities – manufacturing & filling – Section 6
- FO0425-P1-Retail-Dsn : review of sector activities – retail & distribution – Section 7
Conventions & Language used in this report

Bibliographic sources are cited in numerical order thus (2 p xx). Private communications are referenced uniquely by consultant initial and id number thus (DE009).

In addition, this report uses the terms ‘Clean Operations’ and ‘Waste Minimisation’. These concepts were developed by Oakdene Hollins for a previous Defra project on Business Waste Prevention as part of a framework for evaluating the actions a business takes to improve resource efficiency (Approaches), and mechanisms that have catalysed the actions (the Interventions). A brief reference outline to the Approaches is given here:

**Positioning of approaches in response to business drivers including waste**

<table>
<thead>
<tr>
<th>Incremental CHANGE</th>
<th>FOCUS</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean Operations: More radical restructuring of processes “new, green, clean”, often cooperating with others in the supply chain.</td>
<td>Product–Service Innovation: Fundamental redesign of the product and service combination of a business or its suppliers to reduce life-cycle impacts.</td>
<td>Green Products: Redesign, eco-design, light-weighting of products to reduce impact in manufacture, distribution, use or end-of-life by businesses or consumers.</td>
</tr>
</tbody>
</table>

Waste Minimisation: Traditional in-process housekeeping, including Lean, to improve conversion of input to outputs within current production system.

Source: Oakdene Hollins
1 Food Service in Context

The following Section considers Lean practices within the context of food service, including businesses with the SIC codes listed in Table 25.

Table 25: SIC codes for food service operations

<table>
<thead>
<tr>
<th>SIC Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>Accommodation</td>
</tr>
<tr>
<td>55.10</td>
<td>Hotels and similar accommodation</td>
</tr>
<tr>
<td>55.20</td>
<td>Holiday and other short-stay accommodation</td>
</tr>
<tr>
<td>55.20/1</td>
<td>Holiday centres and villages</td>
</tr>
<tr>
<td>55.20/2</td>
<td>Youth hostels</td>
</tr>
<tr>
<td>55.20/9</td>
<td>Other holiday and other short-stay accommodation</td>
</tr>
<tr>
<td>55.30</td>
<td>Camping grounds, recreational vehicle parks and trailer parks</td>
</tr>
<tr>
<td>55.90</td>
<td>Other accommodation</td>
</tr>
<tr>
<td>56</td>
<td>Food and beverage service activities</td>
</tr>
<tr>
<td>56.10</td>
<td>Restaurants and mobile food service activities</td>
</tr>
<tr>
<td>56.10/1</td>
<td>Licensed restaurants</td>
</tr>
<tr>
<td>56.10/2</td>
<td>Unlicensed restaurants and cafes</td>
</tr>
<tr>
<td>56.10/3</td>
<td>Take away food shops and mobile food stands</td>
</tr>
<tr>
<td>56.21</td>
<td>Event catering activities</td>
</tr>
<tr>
<td>56.29</td>
<td>Other food service activities</td>
</tr>
<tr>
<td>56.30</td>
<td>Beverage serving activities</td>
</tr>
<tr>
<td>56.30/1</td>
<td>Licensed clubs</td>
</tr>
<tr>
<td>56.30/2</td>
<td>Public houses and bars</td>
</tr>
</tbody>
</table>

Food service can be categorised into two types of operations, ‘profit’ and ‘cost’:

**Profit food service** – business enterprises where the provision of food and drink are a primary purpose; restaurants, pubs and hotel dining are key examples. Consumers are typically the public, and food is served at a high margin.

**Cost food service** – operations where food service is not the principle focus; examples include hospitals, prisons, schools and staff canteens (though the latter may sometimes be classified as a category independently of both cost and profit). Historically, profit margins have tended to be less important in these situations, although this is changing as the food service operations are increasingly provided by external contractors.

The number of outlets of each type of food service venue can be seen in Figure 83. The food service sector is highly fragmented, with 77% of outlets having fewer than 10 employees, although a small number of large chains do exist, typically within the quick service restaurant sub-sector (1).
2 The Nature of the Evidence

According to the available evidence, Lean activity seems far less common in food service than in food manufacturing and retail. Indeed, two separate trade associations representing food service companies reported that they had not heard of members using Lean tools (DE037), although one of them thought that “some of the larger restaurant chains might” (DE030). It is highly likely that far more activity is being undertaken in the food service sector than is currently being reported upon in the literature. To take one example, almost every restaurant in the country uses differently-coloured chopping boards for meat and non-meat products – this is actually an example of ‘pokayoke’ the Japanese approach to ‘fool-proofing’ a process (DE005); however it is such a straightforward practice that few reports will mention it.

Despite this, a few useful key reports were identified; these themselves sometimes highlighted the need for more attention and listed several caveats on data accumulated – small sample sizes and limited availability of data being two examples (2) (3). In cost food service, in particular, sector-wide research is lacking, though some company- or site-level projects have been reported on. Lean principles, such as Continuous Improvement, measurements and target setting, were apparent within the literature, although typically without explicitly ‘Lean’ nomenclature.

Corporate Social Responsibility (CSR) reports have provided useful insight into some improvements made by organisations within the hospitality sector, though these again rarely refer to ‘Lean’. Few hotel and restaurant/QSR chain reports gave clear indication of the variation in practices across different areas of business – for example, water and energy targets tended to be at a group level, rather than any specific targets set for the food service aspect, and little reporting of this specific environment was seen.
3 Impact Identification

3.1 General causes of waste

Hotels, restaurants, quick service restaurants (QSRs) and pubs generated 3.4 Mt of waste in 2009, with 48% (1.6 Mt) re-used, recycled or composted (2). Waste associated with the hospitality sector is varied (Table 26), with varying sources of arisings, often outside the food service related practices.

Table 26: Sources of waste in the hospitality sector

<table>
<thead>
<tr>
<th>Source</th>
<th>Examples of waste material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>• batteries</td>
</tr>
<tr>
<td></td>
<td>• cardboard packaging</td>
</tr>
<tr>
<td></td>
<td>• food</td>
</tr>
<tr>
<td></td>
<td>• furniture</td>
</tr>
<tr>
<td></td>
<td>• gardening and landscaping waste</td>
</tr>
<tr>
<td></td>
<td>• glass bottles</td>
</tr>
<tr>
<td></td>
<td>• metals</td>
</tr>
<tr>
<td></td>
<td>• polystyrene foam</td>
</tr>
<tr>
<td></td>
<td>• waste cooking oil</td>
</tr>
<tr>
<td></td>
<td>• waste electrical and electronic equipment</td>
</tr>
<tr>
<td></td>
<td>• waste heating oil</td>
</tr>
<tr>
<td>Employee</td>
<td>• food</td>
</tr>
<tr>
<td></td>
<td>• glass bottles</td>
</tr>
<tr>
<td></td>
<td>• paper</td>
</tr>
<tr>
<td></td>
<td>• plastic packaging</td>
</tr>
<tr>
<td>Customer</td>
<td>• aerosol cans</td>
</tr>
<tr>
<td></td>
<td>• aluminium containers</td>
</tr>
<tr>
<td></td>
<td>• batteries</td>
</tr>
<tr>
<td></td>
<td>• cigarette butts</td>
</tr>
<tr>
<td></td>
<td>• food</td>
</tr>
<tr>
<td></td>
<td>• glass bottles</td>
</tr>
<tr>
<td></td>
<td>• paper (e.g. old newspapers)</td>
</tr>
<tr>
<td></td>
<td>• plastic packaging</td>
</tr>
<tr>
<td></td>
<td>• polystyrene cups</td>
</tr>
<tr>
<td>Office</td>
<td>• cardboard packaging</td>
</tr>
<tr>
<td></td>
<td>• fluorescent tubes</td>
</tr>
<tr>
<td></td>
<td>• furniture</td>
</tr>
<tr>
<td></td>
<td>• printer cartridges</td>
</tr>
<tr>
<td></td>
<td>• shredded paper</td>
</tr>
<tr>
<td></td>
<td>• waste electrical and electronic equipment</td>
</tr>
</tbody>
</table>

Source: (4)

Of the 1.5 Mt of waste sent for disposal (mainly to landfill), the greatest arising, by material type, is food waste (Figure 84). The remaining 0.3 Mt consisted of unusual waste types, handled via relatively rare treatment/disposal routes. Of the waste disposed of, 77% was recyclable through existing pathways.
Figure 84: Composition of mixed waste arising in the hospitality sector (excluding cost sector), 2009

Source: (2)

Figure 85 shows the three root causes of food waste in restaurants, although these apply generally to all food service sites in varying ratios. Spoilage is responsible for the smallest proportion of food being discarded, and preparation wastes the greatest; the latter includes ‘unavoidable’ wastes such as bones and vegetable trimmings.

Figure 85: Types of food waste in restaurants

Source: (3)

A survey of restaurants in 2010 (3) listed the most common causes of food waste, given below:

- food is unusable e.g. radish tops, onion skins, banana skins
- food is not dated properly and therefore not cooked before spoiling
- over-ordering (e.g. August is quieter month so need to change regular orders)
- during a busy service food is left out too long on prep benches
- fridge temperatures not recorded properly
- mistakes in cooking, food falling on floor
- over-portioning
- customer food returns due to unsuitable flavouring or over-seasoning.

Many of these causes are preventable, and actions to tackle these arisings are considered in Section 0.

According to WRAP (2), pubs - rather than restaurants - are responsible for the largest tonnage of waste in the UK (see Table 27). However, restaurants have a greater proportion of total waste destined for disposal.
Table 27: Waste produced, recycled and disposed of by UK hospitality sector, 2009 (kt)

<table>
<thead>
<tr>
<th>Sub-sector</th>
<th>Total waste</th>
<th>Mixed (residual) waste destined for disposal</th>
<th>Waste destined for recycling/re-use</th>
<th>Non-mixed waste or mixed waste managed in another way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotels</td>
<td>485</td>
<td>171</td>
<td>303</td>
<td>11</td>
</tr>
<tr>
<td>Pubs</td>
<td>1,610</td>
<td>646</td>
<td>752</td>
<td>213</td>
</tr>
<tr>
<td>QSRs</td>
<td>246</td>
<td>108</td>
<td>135</td>
<td>4</td>
</tr>
<tr>
<td>Restaurants</td>
<td>1,072</td>
<td>548</td>
<td>419</td>
<td>105</td>
</tr>
<tr>
<td>Total</td>
<td>3,415</td>
<td>1,473</td>
<td>1,609</td>
<td>334</td>
</tr>
</tbody>
</table>

Source: Adapted from (2)

A review of the food service sector determined additional environmental impacts of each sub-sector, shown below:

Table 28: Environmental impacts of food service sub sectors in 2010

<table>
<thead>
<tr>
<th>Sub-sector</th>
<th>Energy CO\textsubscript{2}e tonnes per year</th>
<th>Water CO\textsubscript{2}e tonnes per year</th>
<th>Waste CO\textsubscript{2}e tonnes per year</th>
<th>Total CO\textsubscript{2}e tonnes per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business and Industry</td>
<td>64</td>
<td>-</td>
<td>8</td>
<td>72</td>
</tr>
<tr>
<td>Healthcare</td>
<td>234</td>
<td>7</td>
<td>40</td>
<td>281</td>
</tr>
<tr>
<td>Pubs</td>
<td>102</td>
<td>1</td>
<td>4</td>
<td>107</td>
</tr>
<tr>
<td>QSR</td>
<td>47</td>
<td>1</td>
<td>3</td>
<td>51</td>
</tr>
<tr>
<td>Restaurant</td>
<td>79</td>
<td>5</td>
<td>6</td>
<td>90</td>
</tr>
<tr>
<td>Schools</td>
<td>35</td>
<td>2</td>
<td>2</td>
<td>39</td>
</tr>
</tbody>
</table>

Source: (1)

Business and industry includes staff canteens on business and industrial sites, and healthcare includes hospital food supplied to patients. Much variation can be seen across the sub-sectors; although energy is the greatest hotspot in all cases, this is further broken down by practice in Table 29.

Table 29: Energy consuming activities by sub-sector

<table>
<thead>
<tr>
<th>Sub-sector</th>
<th>Tonnes CO\textsubscript{2}e per year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cold Storage</td>
</tr>
<tr>
<td>Business and Industry</td>
<td>12</td>
</tr>
<tr>
<td>Healthcare</td>
<td>57</td>
</tr>
<tr>
<td>Pubs</td>
<td>24</td>
</tr>
<tr>
<td>QSR</td>
<td>7</td>
</tr>
<tr>
<td>Restaurant</td>
<td>13</td>
</tr>
<tr>
<td>Schools</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>123</td>
</tr>
</tbody>
</table>

Source: (1)
3.2 **Hotspots**

The previous section highlighted some of the key environmental impacts associated with the food service sector. This section identifies some of the root causes of these, and considers Lean practices which may be implemented to improve efficiency within these areas.

3.2.1 **Causes of hotspots within the food service sector**

*Table 30: Summary of hotspots and actions to resolve them within the food service sector*

<table>
<thead>
<tr>
<th>Hotspot</th>
<th>Food type</th>
<th>Root Cause</th>
<th>Context</th>
<th>Example action</th>
<th>Lean content</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food waste in hospitality</strong></td>
<td>All</td>
<td>Preparation</td>
<td>Unavoidable</td>
<td>Minimisation difficult, though ensure utilization where possible in alternative areas (e.g. stock/soup production)</td>
<td>Measurement Kaizen</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Overproduction</td>
<td>Measurement Kaizen</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Review of production processes</td>
<td>Measurement Kaizen</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Minimisation difficult, though ensure utilization where possible in alternative areas (e.g. stock/soup production)</td>
<td>VSM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Trim waste</td>
<td>VSM</td>
</tr>
<tr>
<td><strong>Spoilage</strong></td>
<td></td>
<td>Incorrect storage/date labelling</td>
<td></td>
<td>VSM Measurement</td>
<td>Continuous improvement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Measurement Continuous improvement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stock rotation</td>
<td>Continuous improvement 5S</td>
</tr>
<tr>
<td><strong>Energy and greenhouse gas emissions – Hot storage</strong></td>
<td>All</td>
<td>Inefficient equipment</td>
<td>Incorrect size unit for requirements</td>
<td>Install automatic meter reading (AMR) Capex in new technology Assess work environment – control options?</td>
<td>Measurement Continuous improvement 5S Kaizen blitz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Outdated equipment</td>
<td>Lack of local control</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Incorrect use of appliances</td>
<td>Pull system</td>
<td></td>
</tr>
<tr>
<td><strong>Energy and greenhouse gas emissions – Cold storage</strong></td>
<td>All</td>
<td>Inefficient equipment</td>
<td>Incorrect size unit for requirements</td>
<td>Install automatic meter reading (AMR) Capex in new technology ‘Appointment of champions’</td>
<td>Measurement Continuous improvement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Outdated equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Refrigerators left open</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Incorrect use of appliances</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Energy and greenhouse gas emissions – Cooking</strong></td>
<td>All</td>
<td>Inefficient equipment</td>
<td>Outdated equipment</td>
<td>Capex in new technology Review of work area ‘Appointment of ‘champions’</td>
<td>Continuous improvement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Appliances left on while unused</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Incorrect use of appliances</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: Oakdene Hollins*

Note - energy from catering was highlighted in the ‘Hotspots’ section of the report for the hospitality sector. This has been excluded from *Table 30* as root causes are considered to incorporate most of those listed elsewhere, as catering is in itself a foodservice.
4 \textbf{Example Lean Actions}

4.1 \textbf{Kaizen}

Few documents referred to kaizen directly, though the principles of kaizen were often considered, in particular the concept of Continuous Improvement and employee engagement. Kaizen blitz (the very focused, small area kaizen event) were even less frequently referred to, although some examples did exist. A mix of ‘waste minimisation-type’, within-company and ‘clean operations-type’ actions engaging supply were evidenced.

4.1.1 Kaizen blitz

The Danish Glostrup Hospital’s central kitchen practised Lean techniques to improve quality and efficiency within its site (5), including kaizen and kaizen blitz. Kaizen blitz activities were first implemented in cold production, with routines observed, discussed and then optimised – and these areas were found to have excessive handling of products. The kaizen blitz events resulted in change of processes and relocation of equipment in two further areas: the packing room and transport equipment, which have benefited the flow in production. Defects were fixed and equipment optimised to facilitate production routines. Quantitative data on the savings realised by these activities were not available, however.

One aspect of kaizen blitz is ‘red tagging’, a process by which ‘hotspot’ areas of the work environment are ‘tagged’ – marked for removal or improvement. Whilst not labelled as a Lean practice, Yum! Brands restaurant franchisee, Harmann Management, used this system to highlight opportunity to save energy. After identifying high use energy areas, fake $1 bills were placed around restaurants to visually illustrate places where energy might be wasted. Bills were hung on strings from air conditioner grates to remind that any AC setting below 70°F wastes energy. Others were placed by water heaters to show dollars being burned because the water heater settings were too high. The fake dollars were also displayed on floor drains to illustrate how real dollars are washed down the drain every time someone uses a hot water hose in the back of house to wash floors. A booklet and video presentation were created to share good practice, and each restaurant manager was challenged to make $1,000 of energy savings. Within the first month, most restaurants saw energy bill reductions from $4,000 to $3,000. (6)

4.1.2 Continuous Improvement

After implementing various other Lean practices for production processes, Glostrup Hospital’s central kitchen ensured Continuous Improvement was enabled using a white board for employees to note suggestions at any time, and around which a staff meeting was held each morning to discuss suggestions.

McDonald’s has installed an arena for best practice, both for direct impacts and throughout its supply chain. Scorecards have been developed for suppliers to allow understanding of best practice, which is then shared with other suppliers (7). McDonald’s CSR report states it is working with suppliers to achieve “collectively producing more with less – less waste, less pollution and less use of resources during the development of our products.”

The McDonald’s ‘Manugistics’ system of stock control and forecasting significantly reduces food waste and the costs associated with unsold food, and enables the company to pass on savings to customers. The system evaluates how historical store-specific data, local and national events, holidays, promotions, weather and other factors affect demand. It also prevents restaurants from running out of stock and having to rely on expensive emergency deliveries.

Many large hospitality companies are franchises, and the parent corporation has limited control over resource efficiency of franchisees. Subway restaurants are individually owned and are operated by
independent franchisees, but working with the non-profit franchisee owned, Independent Purchasing Cooperatives or Companies (IPCs) franchisees are provided with the best solutions to help them improve their operations focusing on energy efficiency, resource conservation, waste reduction and food safety (8).

The implementation of an Environmental Management System (EMS) can itself be considered a commitment to Continuous Improvement, and many large hospitality corporations adhere to various EMSs (ISO 14001 probably being the most widely recognised in the UK). The Compass Group in UK and Ireland has 144 sites certified to ISO 14001:2004 standard and has several environmental objectives, including several Lean principles, such as colleague environmental engagement and measuring of carbon footprint (9). It is, however, unclear at this stage as to the extent such systems drive Lean uptake.

Accor Hotels is also certified to ISO 14001 for its sites. Each hotel has to create individual objectives for water and energy consumption reduction, and monitors each separately every month (10).

Another kaizen technique is shared good practice across staff and supply chain, taking both staff engagement and Continuous Improvement a little further. Many pub and bar chains offer means of circulating good practice across all their sites: for example, Enterprise Inns promotes best practice through its publican magazine Eagle Eye (11).

Voluntary agreements are another means to commit to Continuous Improvement, as well as sharing good practice. As discussed in Section 4.2.1, the Fairmont group has signed up to the WWF Climate Savers Programme, committing to a 20% reduction in greenhouse gas emissions. Limited voluntary agreements exist across the whole sector, though WRAP is developing a voluntary agreement for hospitality, expected to be of a similar model to their Courtauld Commitment (see Section 6.2).

Table 31 summarises the evidence for the use of kaizen and continuous improvement in the sector.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/ Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glostrup Hospital (in-company)</td>
<td>Food Service (Cost sector - Healthcare)</td>
<td>Central kitchen practised kaizen and kaizen blitz to improve quality; CI practised.</td>
<td>Waste, Raw Materials</td>
<td>n/a</td>
<td>Staff engagement (white boards, meetings for staff suggestions); customer service</td>
<td></td>
<td>(5) (2008)</td>
</tr>
<tr>
<td>Yum! Brands/ Harmann Management (in-company)</td>
<td>Food Service (Profit sector – QSR)</td>
<td>Yum! Brands restaurant franchisee used ‘red tagging’ process to mark areas of work for removal or improvement</td>
<td>Energy</td>
<td>Within first month, energy bill reductions from $4k to $3k</td>
<td>Communication (fake $1 bills illustrate energy/ waste hotspots; DVD &amp; booklet); CSR; staff engagement</td>
<td></td>
<td>(6) (2011)</td>
</tr>
<tr>
<td>McDonald’s (supply chain)</td>
<td>Food Service (Profit sector – QSR); Manufacture &amp; Filling</td>
<td>Scorecards for suppliers to record and share best practice</td>
<td>Waste, Energy, Water, Air pollution</td>
<td>n/a</td>
<td>Supplier engagement; communication; CSR</td>
<td></td>
<td>(7) (2010)</td>
</tr>
<tr>
<td>McDonald’s (supply chain)</td>
<td>Food Service (Profit sector – QSR); Manufacture &amp; Filling</td>
<td>Manugistics’ system for stock control &amp; forecasting</td>
<td>Waste, Cost</td>
<td>n/a</td>
<td>CSR; technological investment</td>
<td></td>
<td>(7) (2010)</td>
</tr>
<tr>
<td>Subway (in-company)</td>
<td>Food Service (Profit sector – QSR); Manufacture &amp; Filling</td>
<td>Independent Purchasing Cooperatives (IPCs) provide franchisees with solutions to improve resource efficiency</td>
<td>Energy, Waste, Raw Materials</td>
<td>n/a</td>
<td>External support (IPCs)</td>
<td></td>
<td>(8) (2011)</td>
</tr>
</tbody>
</table>
4.2 Measurement

Within the food service sector, use of measurement is a common aspect of Lean thinking that is implemented. Metrics used vary significantly across service type, but common themes are apparent. Monitoring and recording of resource usage is important to allow an understanding of where inefficiencies are located. Typical resources measured are considered below:

4.2.1 Greenhouse gas emissions

As part of the WWF’s Climate Savers Program, Fairmont hotel group has measured its total CO\textsubscript{2} footprint according to the UN protocol and has set a corporate-wide target to reduce GHG emissions by 20% below 2006 levels by 2013. This includes measuring its emissions for scope 1 (direct emissions) and scope 2 (electricity consumption) across its 53 managed properties to calculate its current GHG emissions inventory.\textsuperscript{a}

4.2.2 Energy

Several examples of automatic meter reading (AMR) installation were seen, allowing precise recording of energy consumption and evaluation of peak usage. Whitbread implemented AMR for electricity at all sites, enabling the company to establish typical base loads and, against these, identify a hit list of poorly performing sites with relatively high energy consumption. These were subsequently targeted with energy audits to identify where savings could be made (12).

As part of its commitment to a 10% reduction in carbon (see below), Pret A Manger has installed AMRs across sites (13). Similarly, both gas and electricity AMRs have been installed across Marston’s managed pubs, with readings taken at half-hourly intervals. Following the metering, gas and electricity consumption have reduced by 11% across those sites with meters. When coupled with EMSs, this consumption dropped even further, however. An EMS trial was undertaken in 16 pubs falling under one regional manager’s jurisdiction in order to explore the extent to which energy use could be reduced under the full engagement and supervision of the management team. The gas consumption of the 16 pubs decreased by 30-40% and in some cases even more. The improvements were attributed to

\textsuperscript{a} http://www.fairmont.com/corporate-responsibility/environment/green-operations/climatechangeenvironment/
behavioural change, particularly those changes driven by working with landlords and focusing on reducing the overnight consumption (baseload) (14).

### 4.2.3 Food and packaging waste

Iowa Methodist Medical Center used a tracking system for all food waste generated on site. In the first month, the system logged 4,000 lb. (1,814 kg) of waste a week from trimmings, overproduction, expired products and mishandled food. It has since cut that to 1,000 lb. (454 kg) or less (15). The same ValuWaste system was implemented at Mercy Medical Center in Des Moines. After logging waste arisings, the medical centre was found to be producing 14,837 lb. (6,730 kg) of food waste, with an annual cost of $219,712. This has been reduced to 3,238 lb. (1,469 kg) and all staff have been included in development of actions to reduce waste from purchasing, production and menus. Staff have suggested alternative products to use in different dishes and changing rotations in menus.

Two Intel Corporation cafés had been finding forecasting inaccuracies and overproduction the key reason for food waste arisings, and yet had difficulty managing this problem. By implementing a tracking system – with the support of a Lean consultancy - they recorded food waste arisings by type, and mapped trends, allowing for better understanding of forecasting and production’s needs. These actions resulted in combined pre-consumer waste arisings being reduced by 47%. (DE47)

### 4.2.4 Water

Accor Hotels monitors consumption of water on a monthly basis. Individual objectives are created for each site to reduce consumption (10).

Yum! Brands restaurants monitor water at each site. In the US, a specific monitoring and reporting team has been created to review all of the hotspot areas, including water usage per site (6).

Resources do not have to be limited to direct use, however; as mentioned above, the Environmental Scorecards used by McDonald’s encourage suppliers to measure and reduce their environmental impacts. Suppliers provide annual data for energy, water, air and waste relative to units of production.

Table 32 summarises the evidence for measurement in the food service sector.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fairmont Hotel Group</td>
<td>Food Service</td>
<td>Hotel chain measured scope 1 and 2 GHG emissions across 53 managed properties</td>
<td>GHG</td>
<td>n/a</td>
<td>VA (WWF Climate Savers Programme); CSR; supply chain engagement; staff engagement</td>
<td>a (2009)</td>
<td></td>
</tr>
<tr>
<td>(in company &amp; supply chain)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whitbread</td>
<td>Food Service</td>
<td>AMR implemented for electricity at all sites</td>
<td>Energy</td>
<td>n/a</td>
<td>External support (Carbon Trust); CSR; technology investment</td>
<td>(12)</td>
<td></td>
</tr>
<tr>
<td>(in company)</td>
<td>(Profit sector − Various)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pret A Manger</td>
<td>Food Service</td>
<td>AMRs installed across sites</td>
<td>Energy</td>
<td>n/a</td>
<td>CSR; technology investment</td>
<td>(13)</td>
<td>(2011)</td>
</tr>
<tr>
<td>(in company)</td>
<td>(Profit sector − QSR)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/ Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marston’s (in company)</td>
<td>Food Service (Profit sector – Pubs)</td>
<td>Gas and electricity AMRs installed across managed pubs</td>
<td>Energy</td>
<td></td>
<td>Gas &amp; elec consumption cut by 11%; up to 40% savings if combined with EMS</td>
<td>EMS; technology investment; staff engagement</td>
<td>(14) (2010)</td>
</tr>
<tr>
<td>Iowa Methodist &amp; Mercy Medical Centers (in company)</td>
<td>Food Service (Cost sector – Healthcare)</td>
<td>Food waste generated tracked at two sites using ValuWaste system</td>
<td>Waste</td>
<td></td>
<td>Weekly food waste cut from 1.8 t to 0.5 t at one site; and from 6.7 t to 1.5 t at the second site.</td>
<td>Technology investment; staff engagement</td>
<td>(15) (2011)</td>
</tr>
<tr>
<td>Intel Corporation (in company)</td>
<td>Food Service (Cost sector – staff catering)</td>
<td>Tracking system implemented at two cafés for forecasting demand.</td>
<td>Waste</td>
<td></td>
<td>Pre-consumer waste cut by 47%</td>
<td>Technology investment; external support (consultant)</td>
<td>(DE047) (2011)</td>
</tr>
<tr>
<td>Accor Hotels (in company)</td>
<td>Food Service (Profit sector – Hotels)</td>
<td>Water use monitored at sites.</td>
<td>Water</td>
<td>n/a</td>
<td></td>
<td>Technology investment; CSR</td>
<td>(10) (2006)</td>
</tr>
<tr>
<td>Yum! Brands</td>
<td>Food Service (Profit sector – QSR)</td>
<td>Water use at each site.</td>
<td>Water</td>
<td>n/a</td>
<td></td>
<td>Technology investment; CSR; staff engagement</td>
<td>(6) (2011)</td>
</tr>
<tr>
<td>McDonald’s (supply chain)</td>
<td>Food Service (Profit sector – QSR); Manufacture &amp; Filling</td>
<td>Scorecards for suppliers to measure environmental impacts</td>
<td>Waste, Energy, Water, Air pollution</td>
<td>n/a</td>
<td>Supplier engagement; communication; CSR</td>
<td></td>
<td>(7) (2010)</td>
</tr>
</tbody>
</table>

### 4.3 KPIs & Targets

Key performance indicators (KPIs) are used within corporations as a tool to measure performance, often related to sales or commercial aspects of business practice. KPIs are more commonly being used to encourage environmentally sustainable practices, although within the literature reviewed little evidence was found to support this trend in the food service sector. Within Lean principles, KPIs are an effective way to ensure practices are being upheld and achieve waste minimisation goals.

One example of environmental KPIs was seen in McDonald’s (7), with KPIs set in several areas of environmental impact including;

- supplier workplace accountability
- environmental impacts of consumer packaging
- animal welfare
- energy use in the restaurant.

These can be considered as including both ‘waste minimisation’ indicators such as restaurant energy use - kilowatt hours used per transaction count (kWh/TC), and ‘Leaning supply chain operations’ such as the “percent of packaging material that is made from recycled paper”, and the “percent of packaging derived from certified land managed sources”.

Envirowise give general hospitality guidelines on environmental practice, with recommendations for KPIs, though with a note that these will vary depending on business type. Water benchmarking is given in the

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table below, with a recommendation of a KPI of water use per person to assist with improving water efficiency (16).

<table>
<thead>
<tr>
<th>Activity</th>
<th>Water use (litres/person)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff</td>
<td>25-40</td>
</tr>
<tr>
<td>Guest</td>
<td>100-120</td>
</tr>
<tr>
<td>Diner in the restaurant</td>
<td>10-15</td>
</tr>
<tr>
<td>Conference delegate</td>
<td>25-40</td>
</tr>
<tr>
<td>Guest at a function</td>
<td>25-40</td>
</tr>
</tbody>
</table>

* Excludes in-house laundry service
Source: (16)

Target-setting for improvement is another means of measuring performance, and examples of organisations setting waste minimisation and resource efficiency targets were apparent in the literature, although they were not often defined as Lean practice.

As mentioned above, the Fairmont hotel group has a corporate-wide target to reduce GHG emissions by 20% below 2006 levels by 2013. In order to meet this target, Fairmont has implemented several energy efficiency initiatives across its portfolio of hotels; using renewable energy supply where possible, promoting conservation practices among its colleagues and suppliers, and sharing best practices with other organizations. Internal buy-in consisted of awareness-building and efforts to strengthen autonomy and accountability for results. Fairmont communicated company objectives, shared information regarding the climate impact of the company’s portfolio and informed on benefits from reducing the overall corporate footprint to the internal audience as a means to increase staff awareness. Autonomy was strengthened by allowing each property to take ownership in developing strategies to reduce its emissions, and by benchmarking and publishing results from individual properties.

Pret A Manger has committed to a 10% reduction in carbon (measured per kWh per sq ft) compared to a 2009 baseline, to be achieved by the end of 2012. As well as installing AMRs, a competition and league table has been developed between managers. Energy audits have highlighted inefficient equipment, and lighting, air conditioning units and refrigeration equipment have been focussed on, with efficient models installed at all new sites (13).

As part of its Corporate Responsibility strategy ‘Good Together’, Whitbread has committed to several targets, including a 26% reduction in carbon emissions by 2020 and to increase investment in proven green technologies with the aim to achieve significant annual carbon and energy savings. Other targets include 80% diversion of waste from landfill from Whitbread hotels and restaurants by 2012 and a reduction in relative water usage by 20% by 2020 (17).

Greene King has committed to several targets in reductions of resources, and to this end has KPIs in place for reduction of CO₂ emissions, water usage and waste generated (18). Emissions are targeted for a 4% reduction for the year, on a like-for-like basis. There is a commitment to an 80% reduction in waste to landfill by 2012, and water reductions have been put in place - though not yet quantified, due to a technical problem resulting in AMR meters on the hospitality sites being delayed; once a more accurate recording of usage is determined, targets for reduction will be set.

Punch Taverns use a carbon footprint to measure the impact of their business practices. By the end of the financial year 2009-10, a reduction of 13% on 2009 target was achieved; a significant step towards the desired target of 17% by the end of the year 2010 (19).
One food manufacturer with a food service division interviewed for this project reported that it did not necessarily call the tools it used ‘Lean’; however, Lean was “there in the background”. The company had a five year ‘vision’ with a number of resource efficiency targets to be achieved by 2012. These included eliminating all food and packaging waste to landfill, reducing CO₂ emissions and water use by 15%, all of which had been achieved or exceeded (DE018).

Table 34 summarises the evidence for the use of KPIs and targets in the food service sector.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/ Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>McDonald’s (in-company &amp; supply chain)</td>
<td>Food Service (Profit sector – QSR); Manufacture &amp; filling</td>
<td>Environmental KPIs set in supplier workplace accountability, consumer packaging, animal welfare, energy use</td>
<td>Packaging, Waste, Energy</td>
<td>n/a</td>
<td>CSR</td>
<td></td>
<td>(7) (2010)</td>
</tr>
<tr>
<td>Various (in-company)</td>
<td>Food Service (Profit &amp; Cost sector)</td>
<td>Guidelines including KPIs suggested by Envirowise</td>
<td>Water</td>
<td>n/a</td>
<td>External support (Envirowise)</td>
<td></td>
<td>(16)</td>
</tr>
<tr>
<td>Fairmont Hotel Group (in company &amp; supply chain)</td>
<td>Food Service (Profit sector – Hotels)</td>
<td>Target to reduce GHG emissions by 20% below 2006 levels by 2013</td>
<td>GHG</td>
<td>n/a</td>
<td>VA (WWF Climate Savers Programme); CSR; supply chain engagement; communication; staff engagement</td>
<td></td>
<td>(a) (2009)</td>
</tr>
<tr>
<td>Pret A Manger (in-company)</td>
<td>Food Service (Profit sector – QSR)</td>
<td>10% reduction in GHG targeted by end 2012 (2009 baseline)</td>
<td>GHG</td>
<td>n/a</td>
<td>CSR; technology investment</td>
<td></td>
<td>(13) (2011)</td>
</tr>
<tr>
<td>Whitbread (in-company)</td>
<td>Food Service (Profit sector – Various)</td>
<td>Several targets, including 26% reduction in GHG by 2020; 80% waste diversion from landfill by 2012; reduction in relative water usage by 20% by 2020</td>
<td>GHG, Waste, Water</td>
<td>n/a</td>
<td>CSR; technology investment</td>
<td></td>
<td>(17) (2010)</td>
</tr>
<tr>
<td>Greene King (in-company)</td>
<td>Food Service (Profit sector – Pubs)</td>
<td>Targets include GHG emissions cut of 4%; waste to landfill cut by 80% by 2012. Targets for water usage, waste generated planned.</td>
<td>GHG, Water, Waste</td>
<td>n/a</td>
<td>CSR; technology investment</td>
<td>Technical problem (AMR meter installation delay)</td>
<td>(18) (2011)</td>
</tr>
<tr>
<td>Unidentified (in-company)</td>
<td>Food Service; Manufacture &amp; filling (Profit sector)</td>
<td>Food manufacturer with food service division targeted and achieved zero waste to landfill, 15% cut in GHG, 15% cut in water use by 2012.</td>
<td>GHG, Waste, Water</td>
<td>Zero waste to landfill, 15% cut in GH, 15% cut in water use by 2012.</td>
<td>n/a</td>
<td></td>
<td>(DE018) (2011)</td>
</tr>
</tbody>
</table>

---

### 4.4 Value Stream Mapping

The Danish Glostrup Hospital’s central kitchen carried out VSM for a single product to visualise the flow in existing processes (5). The findings from this were used to identify flows of process elsewhere within the kitchen. The mapping exercise found the practice of preparing and storing food for up to three days prior to requirement, in contrast to the Lean ‘pull’ principle of production, causing a hindrance to distribution and creating waste.

As discussed in Section 4.6, process mapping was among a number of tools used by the Radisson Blu hotel and resort chain (20).

Table 35 summarises evidence for the use of VSM in the food service sector.

**Table 35: Evidence for VSM**

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/ Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glostrup Hospital (in-company)</td>
<td>Food Service (Cost sector - Healthcare)</td>
<td>VSM conducted by central kitchen – reveals inventory too high</td>
<td>Waste, Raw Materials</td>
<td>n/a</td>
<td>Staff engagement (white boards, meetings for staff suggestions); customer service</td>
<td>(5) (2008)</td>
<td></td>
</tr>
<tr>
<td>Radisson Blu (in-company)</td>
<td>Food Service (Profit sector – Hotels)</td>
<td>Process mapping used among suite of Lean tools</td>
<td>Waste, Time</td>
<td>n/a (Not possible to isolate from overall savings)</td>
<td>External support (consultants); staff engagement</td>
<td>(20) (2011)</td>
<td></td>
</tr>
</tbody>
</table>

### 4.5 Advanced Tools

Using the example of Glostrup Hospital kitchen (5), further Lean practices were revealed to have effective use within the food service sector. 5S ‘housekeeping’ of storage areas - and then working areas of the kitchen - allowed staff at the site to have optimum organisation of utensils and raw materials, minimising wasteful production.

The report iterated opportunity for use of other advanced tools also, stating “both Lean and Six Sigma can be used as ‘road maps’ that support the practice of TQM within an organisation (Andersson et al. 2006; Dahlgaard & Dahlgaard-Park 2006). However, as Six Sigma is based primarily on statistics, Lean focuses on improving production flow and reducing waste. This difference in approach may be part of the explanation why Lean is more widely applied than Six Sigma (Andersson et al. 2006), and it is also the reason why Lean principles are likely to be more suitable for meal production than either the TQM or the Six Sigma” (5).

Table 36 summarises the evidence for the use of advanced tools in the food service sector.
### Table 36: Evidence for advanced tools

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/ Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glostrup Hospital (in-company)</td>
<td>Food Service (Cost sector-Healthcare)</td>
<td>SS ‘housekeeping’ of storage areas improved organisation of equipment &amp; raw materials</td>
<td>Waste, Raw Materials</td>
<td>n/a</td>
<td>Staff engagement; customer service</td>
<td></td>
<td>(5) (2008)</td>
</tr>
</tbody>
</table>

### 4.6 Mixed Tools

The Radisson Blu hotel and resort chain used a mix of Lean tools to address the process of menu production. Due to the many types of menu (seasonal, bar/restaurant/room service, specific calendar days e.g. Mother’s Day etc.) menu creation was taking up to 18 weeks to complete; the objective was to reduce this to six. Initial task was process mapping, which identified several bottlenecks (e.g. recipe formulation, costings/price and proofing). Further Lean techniques such as brain-storming, and why-why analysis were utilised, highlighting specific areas of Lean waste which were then targeted. Actions included: new menu calendar; project timelines; introduction of key milestones; assigning a menu project manager and support team; weekly menu meetings; introduction of a kitchen ‘menu champion’ and a pokayoke system – error proofing. The business realised many benefits due to these actions, including saving 150 tonnes of food waste per annum, with cost saving of £7,200, and 50 kWh of electricity reduction per year (plus paper and ink etc.) from reduced printing - saving a further £2,000 (20).

In a similar review, Buzzworks Holdings addressed the issue of seasonal menus, using a series of Lean tools including VSM, team brainstorming sessions, why-why analysis and pokayoke. Once implemented, the menu process is reduced from eight weeks to two. Actions include: group meetings for fast, informed decision making; team briefings to ensure staff understand the menu changes; implementation of agreed standards; more staff trained in changing computerized till system; review costs of different formats and their impact; and ownership of menu change process by the group head chef (21).

Starbucks has been working with the Lean Enterprise Institute (LEI) to implement Lean techniques into its everyday practices. This has included 5S organisation of the workspace, and kaizen continuous improvement and staff engagement, with all staff encouraged to come up with ideas for site specific ideas for increased efficiency. An example of improvements made is shown in Figure 86.
Lifespan Catering Services, which delivers 32,000 portions of food daily to hospitals and care homes, has developed a ‘cook chill’ process allowing food to be cooked, cooled down within strict temperature guidelines and safely re-heated at its destination. Typically used for care homes and NHS, the process enables staff and patients to select how much they food they need before it is heated. The initiative, reported on the *Hospitality and Catering News* website in 2010, “limits food waste and subsequent clearing away at the end of mealtimes to a minimum – leading to staff saving time on the mealtime process in general” (4). A range of similar systems developed by other food service organisations (e.g. Sodexo, Compass, apetito, etc), some using advanced steam-technology, are now in use across the UK healthcare sector and are contributing to dramatic reduction in the waste from untouched patient meals.

Unilever Food Services offer tips and tools, based upon several Lean techniques, to allow kitchens to move to more efficient production (23). Key areas of focus are described below:

- **Work smart**: Organised kitchens are more effective – train staff well and engage them through individual responsibilities – give ownership of their station. Assess the work process, and determine if other staff can be used for preparation (examples are given where ‘bottlenecking’ occurs as chief is preparing mains, while a less senior chef could be trained to take on much of the work).
- **Smart preparation** – season dishes during the *mise en place* ( MEP – arrangement of required ingredients, cut, part cooked and ready for use in meal, allowing the chef to cook without having to stop and assemble items), create effective work schedule for optimum MEP batches, create clear indication of who cleans up what, and how often, employ flexible staffing for ease of rotation/replacement (each member can work each station).
- **Allow staff to calculate the number of steps they take for each process to determine if kitchen layout could be improved.**

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*a* Defra. In process. Reducing the environmental impacts of the hospitality and food service supply chain. Written by Oakdene Hollins.
• Ask for ideas – Create a box and ask the work team for ideas relating to efficiency.
• Wise up on waste: Monitor portion size, use scales to measure out portions and ingredients, use a ‘specials’ board for high volume stock, use accurate ordering and stock rotation and “be creative” utilising trimmings in other products - meat trimmings in paté or terrine, vegetable cuttings in soup etc. Use seasonal local vegetables where possible (marked on menus as such rather than specific names of vegetables, to allow fluctuation) to reduce waste and increase convenience.

The cost sector has different requirements to profit sector, though Lean opportunities are still apparent. Glostrup Hospital’s central kitchen was used as a case study for Lean practice in food service in 2008, and many of the Lean tools were applied. These have been individually listed within the specific sections of the report above, yet it is worth noting that the most effective method of improvement was considered a combination of initial VSM, leading to Continuous Improvement, alongside specific 5S techniques in production areas, and kaizen blitz in others. The author notes (5):

“In meal production, the management and staff are forced to consider special routines and the unique characteristics of food, and to take into account legal temperature requirements. This may cause handling procedures that in the Lean terminology are categorised as waste. An example of this was seen in the ‘cold kitchen’ area where optimised procedures still contained non value added handling to ensure the adequate cooling of products. In addition, the meal distribution system at the hospital limited the successful reduction of product waste, because of internal organisational barriers. Thus, the successful application of Lean in meal production depends not only on the internal production planning and performance, but is also influenced by the choice of system, official requirements and work organisation in surrounding systems.”

In terms of Lean practices the Danish study reported improvements in the following areas:
1. Increased flow as a result of optimizing handling routines in selected areas and better planning of the daily production
2. Reduced product waste resulting from changed storage and portioning routines
3. Improved efficiency in storage, transporting and packing procedures
4. A common system involving all employees in improving/evaluating product quality
5. Increased team spirit
6. Reduction of overtime.

It was concluded that these results show that implementing Lean principles and tools have caused positive changes to the focus areas ‘efficiency’ [1-3], ‘product quality’ [4] and ‘working environment’ [5-6].

Another hospital case study showed that using a ‘pull’ system for production can achieve benefits. Initial VSM resulted in a ‘current state’ process highlighting non-Lean operational wastes such as waiting, over-processing, and over-production. Patient interaction was low, and complaints were also reviewed. A ‘future state’ was created, eliminating many of these wastes was created, and an implementation plan conceived in order to meet it. Old, inefficient equipment was removed, and a ‘meals-on-demand’ service offered, giving patients the opportunity to place orders for food around their own schedules. The overall effect was to deliver fresher food which did not have time to cool down, as was a frequent occurrence in the previous ‘state’. Staff were freed up to do more value-added work, and patient and staff morale reportedly improved (24).

Table 37 summarises the evidence for the use of mixed tools in the food service sector.
### Table 37: Evidence for mixed tools

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/ Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radisson Blu</td>
<td>Food Service (Profit sector – Hotels &amp; Restaurants)</td>
<td>Mix of Lean tools (e.g. VSM, brainstorming, why-why analysis, pokayoke) used to speed up menu production</td>
<td>Waste, Raw Materials, Energy, Time</td>
<td>Food waste cut by 150 t/yr (equivalent to £7.2k cost saving); 50 kWh/yr electricity reduction; stationery materials worth £2k saved</td>
<td>External support (consultants); staff engagement ('champions')</td>
<td></td>
<td>(20)</td>
<td>(2011)</td>
</tr>
<tr>
<td>Buzzworks Holdings</td>
<td>Food Service (Profit sector – Restaurants)</td>
<td>Seasonal menu issue addressed with mixed tools (e.g. VSM, brainstorming, why-why analysis, pokayoke)</td>
<td>Waste, Raw Materials, Energy, Time</td>
<td>n/a</td>
<td>External support (consultants); staff and management buy-in ('champions'); technology investment</td>
<td></td>
<td>(21)</td>
<td>(2010)</td>
</tr>
<tr>
<td>Starbucks</td>
<td>Food Service (Profit sector – QSR &amp; Cafés)</td>
<td>Mix of Lean techniques introduced (e.g. 5S, kaizen &amp; CI, etc.)</td>
<td>Waste, Time</td>
<td>n/a</td>
<td>External support (Lean Enterprise Institute); staff engagement</td>
<td></td>
<td>(22)</td>
<td>(2005)</td>
</tr>
<tr>
<td>Lifespan Catering Services (and others) (in-company)</td>
<td>Food Service (Cost sector - Healthcare)</td>
<td>Implementation of cook-chill processes to cut lead times – and improve demand matching</td>
<td>Waste, Time</td>
<td>n/a</td>
<td>Technology investment</td>
<td></td>
<td>(4)</td>
<td></td>
</tr>
<tr>
<td>Various (in-company)</td>
<td>Food Service (Cost &amp; Profit sectors)</td>
<td>Lean tips and techniques for improving kitchen efficiency</td>
<td>Waste, Time</td>
<td>n/a</td>
<td>External support (Unilever Food Service)</td>
<td></td>
<td>(23)</td>
<td>(2011)</td>
</tr>
<tr>
<td>Glostrup Hospital (in-company)</td>
<td>Food Service (Cost sector - Healthcare)</td>
<td>Central kitchen, mixed tools used (e.g. VSM, CI, kaizen blitz, 5S)</td>
<td>Waste, Raw Materials</td>
<td>n/a</td>
<td>Staff engagement; customer service</td>
<td></td>
<td>(5)</td>
<td>(2008)</td>
</tr>
<tr>
<td>Unidentified hospital (in-company)</td>
<td>Food Service (Cost sector - Healthcare)</td>
<td>‘Pull’ system for production introduced; Lean techniques include VSM</td>
<td>Waste, Raw Materials</td>
<td>n/a</td>
<td>Technology investment; external support (consultants)</td>
<td></td>
<td>(24)</td>
<td>(2011)</td>
</tr>
</tbody>
</table>
5 Behavioural Considerations

5.1 Attitudes

Generalising about the food service sector’s attitude to Lean thinking would be dangerous on the basis of such scant evidence, although some initial thoughts arise. For instance, much of the industry – if it is exercised about environmental issues at all – is seemingly focused on ‘end of pipe’ solutions rather than making more efficient use of resources.

5.2 Motivators

As the reports on Manufacturing and Retail have shown, the opportunity to boost profits is a key driver for Lean action. However, for cost food service - where profit margins are not important - this is likely to be less important (although evidence is lacking to support this contention). Alternative drivers may be cited such as the need to improve “quality and efficiency” at the Glostrup Hospital (5), or to reduce ‘complaints’ from service users (e.g. patients).

For the profit food service, financial gains are a clear driver. For the fast-food sector in particular, certain Lean tools such as Kanban are of particular value because an efficient and quick service is so critical.

As with multiple retailers, maintaining a positive public profile is also important for the food service sector, especially with larger organisations. CSR drivers were evidenced by, among others, Whitbread and Greene King, which have both committed to several resource efficiency targets (Section 4.4). However, it is not clear whether more sophisticated forms of Lean thinking were also directly motivated by public image.

The implementation of an EMS (e.g. ISO 14001) can be regarded as both a spur to Lean activities and perhaps an enabler, and is evidenced in some of the literature reviewed.

Membership of some kind of environmentally-themed voluntary agreements (VAs) or award scheme seems also to have motivated Lean action. Examples include the Fairmont hotel group’s work on setting targets for - and monitoring - the carbon emissions of its operations as part of its commitment to WWF’s Climate Savers Program.

5.3 Barriers

Although a handful of good examples are seen of VAs or CSR concerns spurring action among larger enterprises, the highly fragmented nature of the food service sector with numerous SMEs could hamper efforts to effect significant change in this way. By contrast, VAs could be viewed as a good way to achieve results in for example the retail sector.

Perhaps the largest constraint highlighted in the little evidence available is a low level of awareness in the sector of the true cost of waste. This is demonstrated by the relatively low rates of re-use or recycling of waste arising in hotels, restaurants and pubs (2). If most businesses do not even see waste as a problem then the prospects that they will attempt to tackle it through Lean action are very low indeed.

According to an interviewee from a trade association representing restaurants, a fundamental barrier to using Lean to reduce food waste “is that customers don’t know what they want until the very last minute”, so it is very hard to ensure that all the ingredients a restaurant buys actually get used. In addition, menus change all the time (DE030), which parallels the ‘moving goalposts’ problem described in
the retail supply chain. Nevertheless, approaches are available which can keep perishable stocks to a minimum; for instance, advertising ‘specials’ and using experience of which are the most popular dishes. This is easier for big restaurant chains which all have the same menu (DE030).

5.4 Enablers

A key enabler or ‘success factor’, as found with other sectors within the UK food industry, was employee engagement: for instance in the use of a white board or regular staff meetings for staff to input suggestions (5). Another good example is provided by the Fairmont hotel group (see Section 4.2.1) which promoted internal buy-in to Lean actions by communicating company objectives, sharing information and informing staff on the benefits. In addition, the company allowed each property to take ownership in developing strategies. Similarly, the Iowa Methodist Medical Center included all staff in developing waste reduction actions (Section 4.2.3). In addition, Yum! restaurants created a monitoring and reporting team to review hotspot areas (Section 4.2.4), while the Radisson Blu hotel and resort chain introduced a kitchen ‘menu champion’ (Section 4.4). Starbucks Coffee provides a final good example of employee engagement: as discussed in Section 4.6, the chain has implemented a number of Lean techniques into its everyday practices including encouraging all staff to suggest resource efficiency measures.

The well-publicised work on Lean by McDonald’s restaurants provides a rare example of a food service business going beyond the confines of its own operations to engage an entire supply chain to achieve change. As described in Section 4.1.2, the fast food chain has, for instance, developed scorecards for suppliers to disseminate best practice (7). McDonald’s has also developed a sophisticated system of stock control and forecasting known as ‘Manugistics’ which significantly reduces food waste and associated costs (although this arguably could be out of the scope of FO0425 in that it undoubtedly involved a substantial capital outlay).

As with the retail and manufacturing sectors, food service companies have sometimes brought in external Lean consultants to effect change. Examples include Starbucks Coffee’s work with the LEI (Section 4.6). Food service companies were also apparently involved in a Lean programme undertaken by the Defra-funded Food Chain Centre which ran between 2002 and 2007/8 (DE002), although seemingly little evidence is published of the results of this work.
6 Learning

6.1 Insights

The hospitality sector appears to be behind others in terms of production and operational efficiency, with a limited but growing move, in most sectors, to reduce waste going to landfill. There is still a long way to go before consideration of zero waste to landfill, and current focus appears to be diversion of waste rather than reduction, giving ample opportunity for Lean to become incorporated on a larger scale.

Some large companies do offer good examples of Lean practice, both McDonald’s and Starbucks showing significant improvement due to implementation of Lean. They have taken different approaches, with McDonald’s engaging the full supply chain through use of supplier ‘scorecards’ and producing a catalogue of global environmental best practice for dissemination across its estate; Starbucks appears to be more focused on individual sites at present. In particular, measurement, monitoring and the use of KPIs is becoming more widespread, with these historically used for financial assessments of success (profit margins etc.) but increasingly being used for ‘environmental’ success.

Figure 87: Plan – Do – Check – Act model of continual improvement

The ‘plan–do–check–act’ cycle is a four-step model for carrying out change. As a continuous loop, this is used as a model for implementing continuous improvement. In the hospitality food service sector, the examples shown are often considered to be at the first ‘Plan’ stage of the loop (metering, data gathering, learning), with some companies are at the ‘Do’ stage. As an immature practice for the sector, few companies have progressed to the ‘Check’ and ‘Act’ stages of the process, though this is expected to develop as more advanced techniques are implemented and initial benefits are realised.

The structural characteristic of the food service sector - in terms of its fragmented nature - makes the implementation of Lean, in its purist sense, problematic. Evidence of this is highlighted in the fact that so much of the waste generated within the sector is sent for disposal, i.e. only 48% of the waste generated from hotels, restaurants, QSRs and pubs is currently re-used, recycled or composted (2). This is indicative of a sector that does not consider waste as a valuable resource and hence many within the sector would be reluctant to embrace the Lean concept.

There is considered to be a ‘trade off’ by some, in terms of creativity of food production and ‘automation’ reducing the pleasure of a food service experience, but this does not need to be the case. One discussion of Starbucks placed the coffee chain in the middle of such a trade-off, stating “Lean techniques are great for manufacturing, but not for non-repeatable human tasks”, arguing that Starbucks fits somewhere in the middle (25).

Another source argued that the Lean implementation at Starbucks actually improved the ‘customer experience’, giving more time for non-task related jobs, such as talking to customers:
“Instead of having baristas stop and search for things that are in the wrong place, or aren’t there at all, the goal is to make as many things as possible routine, so that the barista can spend just that few more seconds talking to the customer” (26).

The Glostrup Hospital study (5) reports that Lean stems from mass production of non-perishable goods: thus all Lean principles and tools may not be equally applicable in food production, but it is, of course, important to consider this aspect when considering the implementation of Lean in meal production. In addition, it is important to remember that Lean does not, in its original form, address the safety aspects of food production. In meal production, the documentation of food safety is supported by quality control programmes, which are often developed from Hazard Analysis Critical Control Point (HACCP) procedures in agreement with national legal requirements (27). Although Lean aims to deliver value to the customer, it is a production philosophy and not a quality control programme, and there are major differences between Lean and HACCP.

### 6.2 Opportunities

The analysis shows sporadic examples of good Lean practice within the sector. A significant opportunity exists in converting this into average practice for the whole sector. Lean terminology appears to be limited within the sector, with few companies reporting on good practice as ‘Lean’, though principles are the same. Opportunity exists in a basic approach, with understanding and monitoring key: VSM is a good first step to highlight inefficiencies, with measurement, monitoring and Continuous Improvement (kaizen) to be on-going from that point. The Unilever Food Service offers tools for assistance for commercial kitchens, whilst cost sector approaches can be slightly modified. Lean Healthcare Inc offers good advice on ‘meals-on-demand’, moving towards a ‘pull’ system to better meet customer (patient) requirements.

As highlighted in Section 4, Lean is currently implemented in some sub-sectors of hospitality, often in the ‘fast food’ arena, where efficient and quick service is critical. Some of these learnings can be rolled out to other sub-sectors without any negative impact on product. McDonald’s has reduced food waste through the use of an advanced ‘Manugistics’ tool which assists with stock control and forecasting, taking consideration of aspects such as weather, national events, historic trends of the site, and other site specific information. There is opportunity for restaurants and hotels to improve forecasting, potentially reducing wasted and out of date stock going to landfill or disposal.

Other opportunities may exist in mass customisation of food, though this was not evident in literature reviewed. It is understood that certain styles of food restaurant – for example Indian restaurants – use a ‘base’ product for use in several of their end products – adding particular ingredients at a late point in production so as to allow for maximised efficiency of production, with individualisation of meals at a late point.

Voluntary agreements can be considered a means to Continuous Improvement, a key principle of kaizen. The Courtauld Commitment in which the grocery sector initially signed up to various commitments to reduce packaging waste is an example. This agreement has evolved significantly, and is now in its third phase, having incorporated resource efficiency and carbon measurement within the remit.
6.3 **Gaps**

The core gap in this area is in the development of a systematic Lean approach to moving from a predominantly waste disposal type culture to one of resource efficiency. Behavioural change will be a key requirement, and understanding the hotspots and opportunities is imperative for any changes to occur on a large scale. Little is understood in water consumption and there is still limited reporting on specific food sector activities within hotels and other accommodation facilities.

Little evidence was seen on the drivers for Lean when considering the balance of ensuring little out-of-specification stock and handling risks associated with more precise forecasting: meeting the exact needs each time gives potential for under-availability of stock when unexpected demand is seen. Lean preparation techniques may potentially be linked with less ‘margin for mistake’, and result in over-production and more waste.

However, this is considered an area of further investigation, as other food sector sub-sectors such as manufacturing have an accepted level of over-production in order to ensure ‘just in case’ supply (in contrast to ‘just in time’ production).

Little focus was seen on catering pack size and potential waste associated with generic supply; the sector is heterogeneous, and as such catering requirements are varied. VSM may give a more detailed evaluation of the importance of this issue.
7 Bibliography


27. Food safety research underpinning food service systems - a review. Rodgers, Sveltana. 2, s.l. : Food Service Technology, Vol. 5. id 394.

Note: The id numbers at the end of the bibliographic references refer to the source file id number stored at www.infinifile.org.uk. You can access these sources for free, using project id 270 in conjunction with the file id when prompted. Requires registration. The adjacent QR code will take you to the site if you have the smart-phone QR reader app (many are free).
Appendix 5: Manufacturing and filling
FO0425 – Lean Thinking in the Food Chain
Phase 1 Report: Review of sector activities – manufacturing & filling

A report for
Defra

September 2012
This report has been prepared by: Niels Sprong & Dan Eatherley

Checked as a final copy by: Katie Deegan

Reviewed by:

Date:

Contact: dan.eatherley@oakdenehollins.co.uk

File reference number: FO0425-P1-Manuf-Fill.docx

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## Glossary

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<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS</td>
<td>Lean technique</td>
</tr>
<tr>
<td>BRE</td>
<td>bre, formerly Building Research Establishment</td>
</tr>
<tr>
<td>C&amp;I</td>
<td>Commercial and industrial (waste)</td>
</tr>
<tr>
<td>CC2</td>
<td>Courtauld Commitment Phase 2</td>
</tr>
<tr>
<td>CI</td>
<td>Continuous Improvement</td>
</tr>
<tr>
<td>CO₂ e</td>
<td>GHG emissions stated as equivalent tonnes of carbon dioxide</td>
</tr>
<tr>
<td>CRC</td>
<td>UK’s Carbon Reduction Commitment</td>
</tr>
<tr>
<td>CSR</td>
<td>Corporate social responsibility</td>
</tr>
<tr>
<td>DECC</td>
<td>Department for Energy &amp; Climate Change</td>
</tr>
<tr>
<td>DMAIC</td>
<td>‘Define, Measure, Analyse, Improve and Control’ improvement philosophy</td>
</tr>
<tr>
<td>EMS</td>
<td>Environmental management system</td>
</tr>
<tr>
<td>FCC</td>
<td>Food Chain Centre</td>
</tr>
<tr>
<td>FDF</td>
<td>Food and Drink Federation</td>
</tr>
<tr>
<td>FHC</td>
<td>Federation House Commitment</td>
</tr>
<tr>
<td>FMG</td>
<td>Fast moving goods</td>
</tr>
<tr>
<td>FVCA</td>
<td>Food value chain analysis</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse gas</td>
</tr>
<tr>
<td>IGD</td>
<td>The Institute of Grocery Distribution</td>
</tr>
<tr>
<td>KPI</td>
<td>Key process indicator (of performance)</td>
</tr>
<tr>
<td>MAS</td>
<td>Manufacturing Advisory Service</td>
</tr>
<tr>
<td>MSC</td>
<td>Marine Stewardship Council</td>
</tr>
<tr>
<td>n.e.c.</td>
<td>Not elsewhere classified</td>
</tr>
<tr>
<td>NFU</td>
<td>National Farmers’ Union</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-governmental organisation</td>
</tr>
<tr>
<td>NISP</td>
<td>National Industrial Symbiosis Programme</td>
</tr>
<tr>
<td>NPI</td>
<td>New product introduction</td>
</tr>
<tr>
<td>OEE</td>
<td>Overall equipment effectiveness</td>
</tr>
<tr>
<td>POS</td>
<td>Point of sale</td>
</tr>
<tr>
<td>RDA</td>
<td>Regional Development Agency</td>
</tr>
<tr>
<td>RDC</td>
<td>Regional distribution centre (also DC)</td>
</tr>
<tr>
<td>RFID</td>
<td>Radio frequency identification device</td>
</tr>
<tr>
<td>RSPCA</td>
<td>Royal Society for the Prevention of Cruelty to Animals</td>
</tr>
<tr>
<td>RTP</td>
<td>Returnable transit packaging</td>
</tr>
<tr>
<td>SDDG</td>
<td>Sainsbury’s Dairy Development Group</td>
</tr>
<tr>
<td>SIC</td>
<td>Standard Industrial Classification (code)</td>
</tr>
<tr>
<td>SME</td>
<td>Small to medium enterprise (EU definition)</td>
</tr>
<tr>
<td>SMED</td>
<td>Single minute exchange of dies – Lean technique</td>
</tr>
<tr>
<td>SMG</td>
<td>Slow moving goods</td>
</tr>
<tr>
<td>SVN</td>
<td>Sustainable value network</td>
</tr>
<tr>
<td>tpa</td>
<td>Tonnes per annum</td>
</tr>
<tr>
<td>TPM</td>
<td>Total productive maintenance</td>
</tr>
<tr>
<td>UB</td>
<td>United Biscuits plc</td>
</tr>
<tr>
<td>VA</td>
<td>Voluntary agreement</td>
</tr>
<tr>
<td>VSE</td>
<td>Very small enterprise (EU definition)</td>
</tr>
<tr>
<td>VSM</td>
<td>Value stream mapping</td>
</tr>
<tr>
<td>WRAP</td>
<td>Waste &amp; Resources Action Programme</td>
</tr>
</tbody>
</table>

**Units**

Conventional SI units and prefixes used throughout: (k, kilo, 1,000) \( \{M, \text{mega}, 1,000,000\} \)
\( \{G, \text{giga}, 10^9\} \) (kg, kilogramme, unit mass) \( \{t, \text{metric tonne}, 1,000 \text{ kg}\} \)
Context of this Report

This report is one module of the Phase 1 report of the FO0425 project, FO0425-Phase1-Report. It deals specifically with activities occurring within the manufacturing and filling operations of the sector. Conclusions of the report have been abstracted into the Phase 1 Report but readers should read this module for full details of the evidence review.

Conventions & Language used in this report

Bibliographic sources are cited in numerical order thus (2 p xx). Private communications are referenced uniquely by consultant initial and id number thus (DE009).

In addition, this report uses the terms ‘Clean Operations’ and ‘Waste Minimisation’. These concepts were developed by Oakdene Hollins for a previous Defra project on Business Waste Prevention (WR1403) as part of a framework for evaluating the actions a business takes to improve resource efficiency (Approaches), and mechanisms that have catalysed the actions (the Interventions). A brief reference outline to the Approaches is given here:

**Positioning of approaches in response to business drivers including waste**

<table>
<thead>
<tr>
<th>Process</th>
<th>FOCUS</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incremental CHANGE</td>
<td>Clean Operations: More radical restructuring of processes “new, green, clean”, often cooperating with others in the supply chain.</td>
<td>Product-Service Innovation: Fundamental redesign of the product and service combination of a business or its suppliers to reduce life-cycle impacts.</td>
</tr>
<tr>
<td>Radial</td>
<td>Waste Minimisation: Traditional in-process housekeeping, including Lean, to improve conversion of input to outputs within current production system.</td>
<td>Green Products: Redesign, eco-design, light-weighting of products to reduce impact in manufacture, distribution, use or end-of-life by businesses or consumers.</td>
</tr>
</tbody>
</table>

Source: Oakdene Hollins
1 Manufacturing & Filling in Context

This report considers the evidence for Lean thinking in businesses falling into a range of SIC codes encompassing the food and drink manufacturing sub-sectors (Table 38).

Table 38: Food and drink manufacturing SIC codes

<table>
<thead>
<tr>
<th>SIC Code</th>
<th>Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td>Processing and preserving of meat and production of meat products</td>
</tr>
<tr>
<td></td>
<td>10.1</td>
<td>Processing and preserving of meat</td>
</tr>
<tr>
<td></td>
<td>10.11</td>
<td>Processing and preserving of poultry meat</td>
</tr>
<tr>
<td></td>
<td>10.12</td>
<td>Production of meat and poultry meat products</td>
</tr>
<tr>
<td></td>
<td>10.2</td>
<td>Processing and preserving of fish, crustaceans and molluscs</td>
</tr>
<tr>
<td></td>
<td>10.20</td>
<td>Processing and preserving of fish, crustaceans and molluscs</td>
</tr>
<tr>
<td></td>
<td>10.3</td>
<td>Processing and preserving of fruit and vegetables</td>
</tr>
<tr>
<td></td>
<td>10.31</td>
<td>Processing and preserving of potatoes</td>
</tr>
<tr>
<td></td>
<td>10.32</td>
<td>Manufacture of fruit and vegetable juice</td>
</tr>
<tr>
<td></td>
<td>10.39</td>
<td>Other processing and preserving of fruit and vegetables</td>
</tr>
<tr>
<td></td>
<td>10.4</td>
<td>Manufacture of vegetable and animal oils and fats</td>
</tr>
<tr>
<td></td>
<td>10.41</td>
<td>Manufacture of oils and fats</td>
</tr>
<tr>
<td></td>
<td>10.42</td>
<td>Manufacture of margarine and similar edible fats</td>
</tr>
<tr>
<td></td>
<td>10.5</td>
<td>Manufacture of dairy products</td>
</tr>
<tr>
<td></td>
<td>10.51</td>
<td>Operation of dairies and cheese making</td>
</tr>
<tr>
<td></td>
<td>10.51/1</td>
<td>Liquid milk and cream production</td>
</tr>
<tr>
<td></td>
<td>10.51/2</td>
<td>Butter and cheese production</td>
</tr>
<tr>
<td></td>
<td>10.51/9</td>
<td>Manufacture of milk products (other than liquid milk and cream, butter, cheese) n.e.c.</td>
</tr>
<tr>
<td></td>
<td>10.52</td>
<td>Manufacture of ice cream</td>
</tr>
<tr>
<td></td>
<td>10.6</td>
<td>Manufacture of grain mill products, starches and starch products</td>
</tr>
<tr>
<td></td>
<td>10.61</td>
<td>Manufacture of grain mill products</td>
</tr>
<tr>
<td></td>
<td>10.61/2</td>
<td>Manufacture of breakfast cereals and cereals-based foods</td>
</tr>
<tr>
<td></td>
<td>10.61/1</td>
<td>Grain milling</td>
</tr>
<tr>
<td></td>
<td>10.62</td>
<td>Manufacture of starches and starch products</td>
</tr>
<tr>
<td></td>
<td>10.7</td>
<td>Manufacture of bakery and farinaceous products</td>
</tr>
<tr>
<td></td>
<td>10.71</td>
<td>Manufacture of bread; manufacture of fresh pastry goods and cakes</td>
</tr>
<tr>
<td></td>
<td>10.72</td>
<td>Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes</td>
</tr>
<tr>
<td></td>
<td>10.73</td>
<td>Manufacture of macaroni, noodles, couscous and similar farinaceous products</td>
</tr>
<tr>
<td></td>
<td>10.8</td>
<td>Manufacture of other food products</td>
</tr>
<tr>
<td></td>
<td>10.81</td>
<td>Manufacture of sugar</td>
</tr>
<tr>
<td></td>
<td>10.82</td>
<td>Manufacture of cocoa, chocolate and sugar confectionery</td>
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<td>Manufacture of cocoa, and chocolate confectionery</td>
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<td>10.82/2</td>
<td>Manufacture of sugar confectionery</td>
</tr>
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<td></td>
<td>10.83</td>
<td>Processing of tea and coffee</td>
</tr>
<tr>
<td></td>
<td>10.83/1</td>
<td>Tea processing</td>
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<tr>
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<td>10.84</td>
<td>Manufacture of condiments and seasonings</td>
</tr>
<tr>
<td></td>
<td>10.85</td>
<td>Manufacture of prepared meals and dishes</td>
</tr>
<tr>
<td></td>
<td>10.86</td>
<td>Manufacture of homogenised food preparations and dietetic food</td>
</tr>
<tr>
<td></td>
<td>10.89</td>
<td>Manufacture of other food products n.e.c.</td>
</tr>
<tr>
<td></td>
<td>10.9</td>
<td>Manufacture of prepared animal feeds</td>
</tr>
<tr>
<td></td>
<td>10.91</td>
<td>Manufacture of prepared feeds for farm animals</td>
</tr>
<tr>
<td></td>
<td>10.92</td>
<td>Manufacture of prepared pet foods</td>
</tr>
</tbody>
</table>
The food and drink manufacturing industry is the largest manufacturing sector in the UK, with a turnover of £72.3bn and a gross value added of £20.0bn, accounting for 15% of the total manufacturing sector in the UK.\(^a\) The industry employs up to 400,000 workers, representing just under 16% of the overall manufacturing workforce in the UK.\(^b\)

Production in the food and drink sector has been the most resilient of all manufacturing industries after the economic downturn of 2008, with the industry producing at levels over 10% higher than the manufacturing average.\(^c\) In fact, after June 2010 food and drink manufacturing was operating at levels of production above those experienced in 2006. This trend has continued in 2011; where most manufacturing sectors saw sharp decreases in output from the beginning of the year, food and drink processors are operating at their highest levels of production since the Office of National Statistics started measuring manufacturing productivity.\(^d\) A possible explanation is that, in economically uncertain times, whereas people may prefer to postpone the purchase of durable goods they do not choose to save on food.

Food and drink manufacturing has changed drastically over the past decades. Consumer demands and the retail landscape constantly change. For example, both the growing demand of consumers for ‘fresh’ (i.e. short shelf-life) products (DE032) and ever changing ‘food fashions’ means that manufacturers are expected to have low stocks and move to more flexible manufacturing techniques. This has led to a situation in which food manufacturers and fillers face a number of significant challenges:

- On time in full delivery to retail is critical.\(^e\)
- Margins are low due to price competition.
- New product development is an important part of staying competitive.\(^f\)

In practice, the need for low stocks and flexible manufacture means that food manufacturers have to ensure their sites can deal with:

- short production runs
- multiple line changeovers
- complex material controls
- the need for precision and ‘right first time’ production.

\(^a\) [http://www.fdf.org.uk/statsataglance.aspx](http://www.fdf.org.uk/statsataglance.aspx) (Information taken from latest ONS Annual Business Survey, food and non-alcoholic drink only)

\(^b\) From the Business Register and Employment Survey 2009 (BRES)

\(^c\) [http://www.fdf.org.uk/statsataglance.aspx](http://www.fdf.org.uk/statsataglance.aspx)


\(^e\) A University academic with 30 years’ prior experience in the food sector reports that suppliers who fail to deliver to their supermarket customers the correct amount (no more, no less) within a pre-arranged +/- 15 minute window risk being ‘de-listed’ – i.e. being dropped as a supplier altogether (DE032).

To tackle these challenges while increasing resource efficiency is a complicated issue. Many errors can be made in the production process that lead to the arising of waste and other environmental impacts.

Perhaps the greatest challenges are associated with demand forecasting. Errors frequently result in a phenomenon known as ‘demand amplification’ (1 p. 24) whereby slight changes – often a temporary rise – in end-user demand is progressively amplified back up the supply chain resulting in over-production (Figure 88). The underlying problem is that feedback control systems (which provide up-to-date information of actual demand for a specific product) are absent, so managers tend to over-order “just to be on the safe side” (2 p. 9) (3 pp. 488-9) – and manufacturers over-produce for the same reasons.

Figure 88: Demand amplification

Source: Lean & Green Value Chain Analysis. Ready Meals From Butchery to Shelf. SA Partners (2010)

NB: Variations of 32% in orders for a specific steak ready meal from the retailer (Marks & Spencer) results in variations of 55% in steaks being produced by the manufacturer (YPM).

Filling and bottling fall under the general heading of packing – the dispensing of product into its primary packaging – and are often conducted on the premises of the food manufacturer. However, 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. Previous reports state that there is significant opportunity to apply Lean techniques to reduce this (4).

\[\text{\underline{a}}\]

Alternative names for the phenomenon include the ‘bullwhip effect’ (36) or ‘Forrester effect’ (3)
2 The Nature of the Evidence

Several of the stakeholders interviewed for this project reported that companies in the UK food and manufacturing sector generally do not use the language of Lean (e.g. terms such as kaizen, Kanban, SMED etc.), even when what they are doing on a day-to-day basis to optimise operational performance could be seen as Lean thinking. As one trade association representative points out, dairies milk their cows on one day and deliver the product to shops and doorsteps the next: “they’ve been doing Lean for years!” (DE003). This tendency to avoid using the language of Lean is reflected in much of the published literature reviewed for this project. Very little material explicitly uses Lean terminology in relation to improvements in operational and environmental performance; the documents that take a prominent place in this review fall into only a handful of categories:

- progress reports toward multi-sector voluntary agreement targets
- progress reports toward sector voluntary agreements
- Lean or Lean-like case studies.

In gathering evidence for this report, literature was selected and evaluated on the basis that it referred - explicitly or implicitly - to at least one of nine types of Lean tool chosen by the project team:

- Kanban
- kaizen
- single minute exchange of dies (SMED)
- value stream mapping (VSM)
- 5S
- 6Sigma
- rationalisation
- metering
- key performance indicators (KPIs).

Section 4 in this report provides an overview of how these techniques may play a role in actions reported by food and drink manufacturers to achieve environmental benefits.

It should be noted that many documents mention environmental improvements and actions taken to accomplish these improvements, but where sources did not explicitly mention the process that led to the specific action these were excluded. Without further evidence, such examples had to be considered as ‘opportunistic’. Examples of actions requiring significant capital investment were also omitted, especially in the absence of a clear Lean process preceding it. Moreover, actions requiring substantial financial input are unlikely to be an option for smaller food manufacturers.

Moreover, the possibility should not be excluded that far more ‘true’ Lean processes are being used by food manufacturers that simply have not been reported in the published literature. This seems highly likely since a Lean consultant (involved in the Food Chain Centre programme) interviewed for this project reported that a good proportion, “a third to a half”, of the larger manufacturers have a working knowledge of Lean (DE002). Most food manufacturers are not subject to the same pressures (e.g. CSR pressures) to publicise their environmental improvement actions as those faced by multiple retailers. In fact, competitive pressures may operate in the opposite direction, with manufacturers unwilling to give away trade secrets to the competition.

The review is therefore likely to understate the use of Lean processes used in the food and drink manufacturing sectors.
3 Impact Identification

3.1 General impacts/non-hotspots

In food and drink manufacturing, the major sources of energy used are natural gas (61%) and electricity (31%). The major end use of the energy, at 63% of total consumption, is in low temperature processes. An alternative decomposition of sectoral energy use identifies boilers as being the primary application accounting for 49% of total consumption, followed by heating at 27%. (2)

Evidence from the food and drink sector (7) shows that waste arisings have fallen progressively over time, by 33% between 1998 and 2009, even as turnover has increased over the period; this trend was also observed in other studies (4) (8). This puts waste arising at 5.8 Mt for 2009, the year of the latest C&I waste survey.

Animal and vegetable wastes account for half of the waste arising in 2009. Much of the waste arises from larger firms, with companies with 250 or more employees being responsible for 60% of the arisings. A 2010 WRAP report estimated the waste arising of food manufacturing at 5 Mt with a further 2.2 Mt of by-product sent to animal feed (4).

NB. The following Sections summarise the main findings from the FO0425-P1-Hotspots module – please refer to that report for original sources of the data.

3.1.1 Meat & poultry

During the manufacturing stage of meat & poultry, 454 ktCO₂e are generated per year, 65% of which arises from mechanically intensive poultry processing. 1.4 Mt of waste arise annually from the fresh meat retail supply chain, of which 97% derives from abattoirs and cutting plants. The manufacturing stage of the fresh meat supply chain is the most water-intensive, using approximately 12 Mm³ of water annually for slaughtering and cutting.

3.1.2 Fresh fish & seafood

The total volume of waste and co-products arising in the fresh fish & seafood supply chain is estimated at 140 kt per year, 94% of which arises during the processing and production stage. The fish and seafood supply chain is highly water-intensive: thawing, washing and filleting production processes all require significant water use.

3.1.3 Fruit & vegetable

The overall waste arising in the fruit & vegetable supply chain is estimated to be 2.2-2.5 Mt, which equates to a 30-50% loss of product over the supply chain, but not all of which is avoidable.

3.1.4 Dairy

In the dairy supply chain the GHG emissions for liquid milk are estimated at 1.18 kgCO₂e per litre of milk (15.5 Mt total), of which the major impact (85%) is during raw milk production, with packaging, milk processing and transport accounting for most of the remainder (0.18 kg/litre). It has been estimated that for every litre of milk consumed 1.3 litres needs to be produced, equating to losses of around 23% in the supply chain. The greatest losses occur within households (0.18 litres) and in dairy processing (0.08 litres). The latter amounts to around 1 Mm³ of water with an impact of 2.3 Mt of CO₂e.
3.1.5 Bakery

In the bakery sector, the carbon footprint of an 800g loaf of bread was estimated at 1.1-1.2 kgCO$_2$e. The greatest life cycle impacts were estimated for wheat production, and for toasting and chilling in the use phase. Manufacturing accounted for around 16% of the total footprint. The Carbon Trust estimated that ovens accounted for 35-45% of CO$_2$ emissions from the industrial baking process.

3.1.6 Pre-prepared chilled & frozen and ambient

For pre-prepared chilled & frozen, 12% of carbon impacts are estimated to be in the manufacturing stage. Within the ambient product supply chain, the production stage is identified as the major 'hotspot' contributing to GHG emissions.

3.1.7 Drinks

For the drinks sector, GHG impacts are spread between different stages across the life cycle. While ingredients are an important hotspot, so are packaging, manufacture and distribution and retail. Raw ingredient yield losses for drinks vary according to their type, but typical yield losses are 2-7%. Alcoholic drinks such as wine, gin and vodka typically have yield losses near 2%, the majority of which is from filtration and residues. For soft drinks where the cost of ingredients is lower, losses can be near 7% and include product giveaway, set-up and run-down losses.

3.2 Hotspots

A 2007 Defra study estimated the no-cost, low-cost resource efficiency savings within food and drink manufacturing at 19.3% of all saving opportunities, equivalent to £995m per year (5).

The root causes of wasteful activity in food manufacturing can be split up into four main categories: management factors, process factors, product factors, and environmental factors (4) (Table 39).

<table>
<thead>
<tr>
<th>Type of factor</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>Demand forecasting errors</td>
</tr>
<tr>
<td></td>
<td>Information sharing</td>
</tr>
<tr>
<td></td>
<td>Shelf life policies</td>
</tr>
<tr>
<td></td>
<td>Inventory management</td>
</tr>
<tr>
<td></td>
<td>Stacking and shelving</td>
</tr>
<tr>
<td></td>
<td>Penalties and availability targets</td>
</tr>
<tr>
<td></td>
<td>Lack of employee training and awareness</td>
</tr>
<tr>
<td></td>
<td>Corporate liquidations</td>
</tr>
<tr>
<td>Process</td>
<td>Overfills and shortfills</td>
</tr>
<tr>
<td></td>
<td>Operator error</td>
</tr>
<tr>
<td></td>
<td>Poor quality production</td>
</tr>
<tr>
<td></td>
<td>Preparation waste</td>
</tr>
<tr>
<td></td>
<td>Inefficient dispensing of supplies</td>
</tr>
<tr>
<td></td>
<td>Over-ordering of raw materials</td>
</tr>
<tr>
<td></td>
<td>Line spillages</td>
</tr>
<tr>
<td></td>
<td>Change-overs</td>
</tr>
<tr>
<td>Product</td>
<td>Product characteristics</td>
</tr>
<tr>
<td></td>
<td>Over- or under-packaging</td>
</tr>
<tr>
<td></td>
<td>Product damage</td>
</tr>
<tr>
<td></td>
<td>Product recalls</td>
</tr>
<tr>
<td></td>
<td>Poor conformity</td>
</tr>
<tr>
<td></td>
<td>New product development</td>
</tr>
<tr>
<td></td>
<td>Dropped products</td>
</tr>
<tr>
<td>Environment and consumer</td>
<td>Customer trends</td>
</tr>
<tr>
<td></td>
<td>Weather and seasonality</td>
</tr>
<tr>
<td></td>
<td>Catastrophic failures</td>
</tr>
<tr>
<td></td>
<td>Cancelled promotions</td>
</tr>
<tr>
<td></td>
<td>Last-minute customer order cancellations</td>
</tr>
</tbody>
</table>

Source: Oakdene Hollins

In the Hotspots report, the impacts in specific manufacturing sectors apparently offering the most promising opportunities for improvement were identified, and are summarised in Table 40.
Table 40: Hotspots in food and drink manufacturing

<table>
<thead>
<tr>
<th>Manufacture</th>
<th>Meat &amp; poultry</th>
<th>Fish &amp; seafood</th>
<th>Fruit &amp; vegetables</th>
<th>Dairy</th>
<th>Bakery</th>
<th>Pre-prepared</th>
<th>Ambient</th>
<th>Drinks</th>
</tr>
</thead>
</table>

Key: G = GHG; E = Energy; W = Waste; R = Resource; L = Water

Table 41 presents possible underlying causes of the hotspots, the contexts within which the causative factors operate, and examples of initiatives to address the hotspots. The final column identifies, where known, the type of Lean thinking employed in these activities.
### Table 41: Summary of actions taken to eliminate wasteful activity in food and drink manufacturing

<table>
<thead>
<tr>
<th>Hotspot</th>
<th>Food type</th>
<th>Environmental wastes</th>
<th>Root Cause</th>
<th>Context</th>
<th>Example actions</th>
<th>Lean content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruminant</td>
<td>Red Meat (E)</td>
<td>• Losses in trimming&lt;br&gt;• Out of specification products&lt;br&gt;• Packaging defects&lt;br&gt;• Product waste in unnecessary steps</td>
<td>• No good overview of activities in chain&lt;br&gt;• Poor idea of customer desires&lt;br&gt;• Complicated material handling systems</td>
<td>• Imperative of on-shelf availability&lt;br&gt;• Promotions – especially when short-shelf life products&lt;br&gt;• Rising consumer demand for ‘fresh’ and varied produce&lt;br&gt;• Price competition</td>
<td>• Improved demand forecasting methodology&lt;br&gt;• Development of KPIs to reduce waste</td>
<td>CI KPIs VSM Kanban</td>
</tr>
<tr>
<td>Fish and seafood (GER)</td>
<td>Salmon Shellfish Whitefish</td>
<td>• Water</td>
<td>• Various inefficiencies</td>
<td>• Use of traditional processes</td>
<td>• In depth review of usage and targeted reductions</td>
<td>Kaizen event</td>
</tr>
<tr>
<td>Fruit and vegetables</td>
<td>Potatoes</td>
<td>• Potato peelings&lt;br&gt;• Water</td>
<td>Not given</td>
<td></td>
<td></td>
<td>Not given Kaizen event</td>
</tr>
<tr>
<td>Dairy (GEWL)</td>
<td>All dairy</td>
<td>• Waste and raw materials in non-value adding steps&lt;br&gt;• Inventory losses</td>
<td>• Information complexity high and no good overview of activities&lt;br&gt;• Bad demand management&lt;br&gt;• Poor understanding of customer value&lt;br&gt;• Suboptimal ‘right first time’</td>
<td>• Imperative of on-shelf availability&lt;br&gt;• Promotions – especially when short-shelf life products&lt;br&gt;• Rising consumer demand for ‘fresh’ and varied produce&lt;br&gt;• Price competition</td>
<td>• Reduce number of steps&lt;br&gt;• Decrease information complexity&lt;br&gt;• Improve forecasting methodologies</td>
<td>CI VSM Kanban KPIs</td>
</tr>
<tr>
<td>All dairy</td>
<td>• Product waste</td>
<td>• Spoilage due to bad forecast methodology</td>
<td>• Imperative of on-shelf availability</td>
<td></td>
<td>• Improved forecast methodology</td>
<td>Kanban</td>
</tr>
<tr>
<td>Industrial Bakery (GE)</td>
<td>Cake</td>
<td>• Packaging wastes</td>
<td>Not given</td>
<td></td>
<td>• Improvements on different points on the line</td>
<td>Measuring</td>
</tr>
<tr>
<td>Pre-prepared (GER)</td>
<td>Cornish pasties</td>
<td>• Wasted energy from heating, cooling and lighting during downtime</td>
<td>• Low efficiency at product changeovers</td>
<td>• Step change improvement toward more line utilisation</td>
<td></td>
<td>SMED Kaizen</td>
</tr>
<tr>
<td>Ambient (GER)</td>
<td>Biscuits Snacks</td>
<td>• Factory waste</td>
<td>• Over usage of raw materials&lt;br&gt;• Production inefficiencies</td>
<td>• Rising raw material prices</td>
<td>• Step-wise improvement of production lines</td>
<td>Kaizen events</td>
</tr>
<tr>
<td>Canned ready meals</td>
<td>• Product waste</td>
<td>• Overfilling</td>
<td>• Legislation on filling becomes target rather than optimal targets</td>
<td>• Analysis of filling records</td>
<td></td>
<td>6sigma</td>
</tr>
<tr>
<td>Drinks</td>
<td>Beer (GEWR)</td>
<td>• GHG</td>
<td>• No sub-meters for estimating CO₂ emissions</td>
<td>• Climate Change Agreements</td>
<td>• Step-wise improvement to carbon reduction</td>
<td>Metering, KPIs</td>
</tr>
<tr>
<td>Soy products</td>
<td>• Steriliser heat losses</td>
<td></td>
<td>• No insight into carbon impact of different processes</td>
<td>• Five-fold Environmental Ambition targets</td>
<td>• Modified sterilisers</td>
<td>Metering</td>
</tr>
</tbody>
</table>

*Source: Oakdene Hollins*
4 Example Lean Actions

A 2010 article in *Trends in Food Science & Technology* notes a general increase in the implementation of Lean processes in the food processing industry, with the aim of staying competitive (6). This chapter outlines in what way these practices are reflected in the literature.

In general, the categorisation shows that certain tools (e.g. CI, measurement, environmental KPIs, etc.) are more prevalent than others. Value stream mapping (VSM) and the more advanced tools including highly statistical approaches (e.g. 6 Sigma), the systematic application of good housekeeping principles, faster changeovers in production lines and moving toward just-in-time production are seen less frequently in published literature. However, the advanced tools were mentioned reasonably often during the interviews conducted for this project.

It should be noted that all tools in the Section below are interlinked. If a company commits to Continuous Improvement and installs meters to measure this improvement, it would have used two Lean-type tools. The results achieved through various actions are only specifically pointed out when it is clear that these results are a direct result of a specific action.

### 4.1 Kaizen & Continuous improvement

#### 4.1.1 Sector and multi-sector initiatives

Kaizen is not a tool but “another word for Continuous Improvement,” noted one Lean consultant interviewed for this project (DE035); and Continuous Improvement is not a technology that can be installed and rolled out within a manufacturing site, but involves changing attitudes and behaviours of personnel. To change the attitude toward continuous environmental improvement, sector-wide, voluntary agreements and ambitions or sector level support often serve as catalysts. Examples include:

- In its progress reports on their *Five-fold Environmental Ambition* sustainability strategy, the Food and Drink Federation outlines the results achieved by suppliers, customers, stakeholders, employees and policy makers working together to develop the skills to deliver Continuous Improvement in the use of energy, water and other natural resources (7). The yearly progress reports outlining the improvements should ensure that companies are committed to these improvements.
- The progress reports toward the Federation House Commitment show that a set of food and drink manufacturers are committed to Continuous Improvement in water reduction (8).
- Similarly, by presenting its figures on environmental improvements over the years, the British Beer and Pub Association shows that the sector is committed to Continuous Improvement for a variety of environmental impacts (9). Through communication with its members it shares good practice in waste reduction, energy reduction, and packaging reduction.
- In the brewing industry, the Industrial Energy Efficiency Accelerator states it aims to “bring about a step change reduction in CO$_2$ from industrial processes by accelerating innovation in process control and the uptake of low carbon technologies” (10).
- As part of the supply-chain wide Dairy Roadmap, Dairy UK will be planning a number of events over the next 12 months to promote best practice within the sector. By committing to presenting an annual sustainability report presenting progress toward the targets, dairy processors are committing to continuous improvement (12). This could be viewed as a rare example of a ‘clean operations-type’ action engaging supply chains rather than just focusing on within-company activity.

The literature shows that, in the UK, many of the companies that are overtly committed to Continuous Improvement are also involved in either sector level agreements targets or multi sector targets. Many of the other tools described in the other Sections on Lean tools are used in actions to continuously improve.
4.1.2 Company commitment

In a 2006 study on Lean practices among food manufacturers in the US, all of those surveyed reported that they had at least one Continuous Improvement scheme in place (13). Similarly, the results of a survey in the Canadian food sector indicated that more than half of the respondents used a type of Continuous Improvement tool (14). Similar studies for the UK are not available, there are however a few examples of how companies focus on continuous improvement, which focus on within-company “waste minimisation-type” activity:

By committing to the publishing of CSR reports which regularly include an environmental section, an organisation implicitly agrees to a type of continuous improvement. For example, in its 2010 CSR report, Kraft states that it is committed to continuous environmental improvement (15). Examples are numerous, with most of the FTSE 250 publishing yearly CSR reports. Most of the CSR reports present in the literature database were indeed from large companies; examples include companies like Coca-Cola, Britvic, Diageo, Campbell and Kellogg’s.

By committing to Environmental Management Schemes there is a corresponding commitment to continuous improvement. For example, last year Britvic rolled out ISO 14001 in its Huddersfield plant (16). Likewise, in 2008 apetito’s food business was certified (7). All of Nestlé’s factories in the UK are certified (7). In anticipation of future climate change regulations, three of Kellogg’s UK plants have an ISO 14001 accreditation (17) as have Dairy Crest operations (8). Elsewhere, United Biscuits reports the implementation of an Environmental Management system (7).

There are also companies that have been focusing on Continuous Improvement for a prolonged period of time. For example, British Sugar states it has long focused on Continuous Improvement in minimising raw material loss, currently producing 2.3 Mt of product and less than 4 kt of waste (18).

Other companies seem to have adopted targeted Continuous Improvement schemes more as a reaction to voluntary agreements or ambitions. For example, apetito frozen food has been able to reduce its CO₂ emissions by 11% over the past two years by effective energy management; factory energy use alone was reduced by 14% in 2009 by focusing on a programme of monitoring and step-by-step improvements (7).

Additional evidence of Continuous Improvement comes from the interviews conducted for this project. For instance, a representative from a large manufacturer of chilled foods reports that, with the assistance of hired-in consultants, his company is actively working on improving productivity, reducing waste and continuous improvement. Sometimes specific business units will have their own ‘CI’ manager. However, as mentioned in Section 5.3, the same interviewee reveals that constant major and minor changes to products can hamper Continuous Improvement (DE004).

Sometimes kaizen approaches are undertaken as part of a wider Lean thinking. For instance, kaizen is considered as just one element of an advanced Lean system called Total Productive Maintenance (TPM) which has been developed by a large drinks manufacturer interviewed for this project (Section 4.5) (DE013).

4.1.3 Employee engagement

Another common theme is the tackling of wasteful activity through Continuous Improvement by stimulating employee engagement. The literature provides examples of bottom-up improvement strategies being of vital importance to improved environmental performance in companies. Again these examples would generally fall into the category of within-company ‘waste minimisation-type’ activity:

To prevent waste during the manufacturing process, United Biscuits developed a programme of employee engagement in waste reduction at all of its manufacturing sites. This has proved remarkably successful, having delivered an 18% reduction in food waste in the first eight months of 2008 compared with the same period in 2007 (19). In 2008, United Biscuits achieved water savings of 17% making small incremental changes throughout its sites. The company again stresses the
importance of a positive attitude among United Biscuits’ employees, who have embraced the new green goals - including water use - that were launched at the start of 2008. The company keeps them regularly informed on progress through detailed updates which have encouraged competition between sites (8). The focus on Continuous Improvement and employee engagement has also led to a reduction in water use of 28% in the period 2007-2009 (7).

Burtons, the biscuit manufacturer, has made many savings on CO₂ emissions over time, reducing these by 1,322 tonnes (10%) between 1999 and 2007, particularly through employee awareness of energy efficiency. The company intends to go on embedding in its culture a “Continuous Improvement attitude” toward CO₂ emission reductions (19).

Walkers performed a comprehensive review of water use at each site in 2006. This review allowed the company to drive down water usage through a range of engineering solutions and employee engagement (19).

Similarly, Britvic has a commitment to managing its water consumption and actively encourages employees to suggest practical ideas and to champion environmental efficiencies to help achieve company goals (19).

Awareness and ‘turn off’ campaigns have previously been used to good effect by the salad supplier Hazeldene, at its Wigan plant. It managed to save in excess of 20% of its water usage, some 70,000 m³ a year, through a minimisation campaign and a £15k spend on a simple engineering solution. Learning and best practice from Hazeldene are being shared across the Group (8).

Dairy Crest has started a process of raising awareness of water as a precious resource at its Severnside site in Gloucestershire. Bi-monthly newsletters keep employees up-to-date on site improvements toward greater water efficiency (19).

Some companies have boosted these bottom-up Continuous Improvement strategies by appointing what they call ‘environmental champions’. The literature provides some examples of this:

Part of the 42% reduction in water use Walkers achieved was through training for employees, including the establishment of water champions and tracking water usage between lines and shifts (8).

Dairy Crest has also trained utility champions in each department of its Gloucestershire site, delivering part of the 6% savings in water use made between 2006 and 2007 (19).

4.1.4 Kaizen events

Kaizen events (or kaizen bursts) are intensive, focused events of business process improvement typically targeting rapid results. In this literature review, many of the operations consultancy case studies and support actions that aim at accomplishing a set of specific environmental improvements describe kaizen or kaizen-like events. As these events often aim at making rapid improvements which establish the basis for Continuous Improvements after the exercise, these are called kaizen events. Examples of kaizen events (or kaizen-like) events in the literature were the following:

In the fish processing industry, many processors are now looking at how they can move away from water-intensive traditional methods in fish processing to methods that use less water. As a result of these discussions, three companies undertook Envirowise waste prevention reviews (WPRs) which focused on minimising water usage, in which the project teams in salmon processing, shellfish processing and whitefish processing came up with specific interventions for water use reductions on these sites (20).

Operations consultants Suiko report the organisation of kaizen-like events at Fox’s biscuits, where through employee training an increase from 74% to 85% in operation equipment effectiveness was realised and factory waste was reduced by 26%. A special action team for over-usage of chocolate managed to reduce robot waste by 17%, post-robot waste by 62% and pre-enrober (a device to coat wafers and biscuits with chocolate) waste by 100% (21).

Similarly, after a visit from Suiko, SADAFCO dairy and foodstuffs is seeking out opportunities across the whole plant having rolled out the Continuous Improvement practices across all areas, including non-operational support functions (21).
A case study of a kaizen event at a snack factory reported a Lean pilot project that, through workshops with team managers and shift leaders, developed a methodology for improving production. The team achieved a 50% increase in output. A 40% improvement in efficiency was realised across the site, reducing waste by 35% (22).

The National Industrial Symbiosis Programme in Northern Ireland visited Wilson’s Country Ltd, a potato processor, to assist the company in dealing with the challenges of waste generation and water usage. Wilson’s had been proactive in cataloguing economic and environmental costs of its processes, and after an assessment of its resources NISP was able to provide valuable advice on cost saving and landfill diversion. This exercise was able to accomplish 1,220 tons of CO$_2$ reduction, diverted 250 tonnes of waste from landfill, and save 250 tons of virgin raw materials. To ensure continuous improvement, the next resource efficiency stage focuses on reduction in water use and water recycling (23).

The rapid and often significant improvements that can be made through kaizen events show that there is often value in a critical review of manufacturing processes to find out how Lean or Lean-like processes can contribute to more resource efficient operations. As the abovementioned examples make clear, much of the reported effort towards continuous improvement and kaizen takes the form of within-company ‘waste minimisation-type’ initiatives rather than ‘clean operations-type’ efforts to engage entire supply chains.

Table 42 summarises the evidence for the use of kaizen and continuous improvement in the food manufacturing & filling sector.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/ Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various (supply chain)</td>
<td>Manufacture; Filling</td>
<td>CI in use of natural resources an aspect of progress reports</td>
<td>Energy, Water, Waste</td>
<td>n/a</td>
<td>VA (FDF Five-fold Environmental Ambition); Supply chain engagement; trade association support</td>
<td></td>
<td>(7) (2010)</td>
</tr>
<tr>
<td>Various (in-company)</td>
<td>Manufacture; Filling</td>
<td>Commitment to CI in water reduction an aspect of progress reports</td>
<td>Water</td>
<td>n/a</td>
<td>VA (FHC); staff engagement</td>
<td></td>
<td>(8) (2009)</td>
</tr>
<tr>
<td>Various (in-company)</td>
<td>Manufacture; Filling</td>
<td>Commitment to CI for a variety of environmental impacts in brewing sector</td>
<td>Waste, Energy, Packaging</td>
<td>n/a</td>
<td>Trade Association support (BBPA)</td>
<td></td>
<td>(9) (2011)</td>
</tr>
<tr>
<td>Various (in-company)</td>
<td>Manufacture; Filling</td>
<td>Brewing industry targeting process CO$_2$ reduction</td>
<td>GHG</td>
<td>n/a</td>
<td>External support (Industrial Energy Efficiency Accelerator); technological investment</td>
<td></td>
<td>(10) (2011)</td>
</tr>
<tr>
<td>Various (supply chain)</td>
<td>Manufacture; Filling</td>
<td>Dairy processors commitment to CI</td>
<td>Various</td>
<td>n/a</td>
<td>VA (Dairy Roadmap); external support (Defra funding)</td>
<td></td>
<td>(12) (2009)</td>
</tr>
<tr>
<td>Various (in-company)</td>
<td>Manufacture; Filling</td>
<td>US &amp; Canadian food manufacturers report CI schemes/tools</td>
<td>Various</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td>(13) (2006); (14) (2009)</td>
</tr>
<tr>
<td>Various (in-company)</td>
<td>Manufacture; Filling</td>
<td>Commitment to CI among larger manufacturers (e.g. Kraft, Kellogg’s, Britvic, Diageo, etc.)</td>
<td>Various</td>
<td>n/a</td>
<td>CSR</td>
<td></td>
<td>(15) (2010)</td>
</tr>
<tr>
<td>Company</td>
<td>Sector(s) impacted</td>
<td>Description</td>
<td>Target resources</td>
<td>Savings</td>
<td>Drivers/ Facilitators</td>
<td>Barriers (if specified)</td>
<td>Source (Year)</td>
</tr>
<tr>
<td>------------------------------</td>
<td>--------------------</td>
<td>------------------------------------------------------------------------------</td>
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<td>---------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Various (in-company &amp; supply chain)</td>
<td>Manufacture; Filling</td>
<td>Implementation of EMS (e.g. ISO 14001) as example of CI</td>
<td>Various</td>
<td>n/a</td>
<td>VA (FDF Five-fold Environmental Ambition; FHC); staff engagement; supply chain engagement, trade association support; EMS</td>
<td>(7) (2010); (8) (2009); (16) (2009); (17) (2008)</td>
<td></td>
</tr>
<tr>
<td>British Sugar (in-company)</td>
<td>Manufacture; Filling</td>
<td>Long term focus on CI in minimising raw material loss</td>
<td>Waste</td>
<td>Less than 4 kt waste per annum for 2.3 Mt of product</td>
<td>CSR</td>
<td>(18)</td>
<td></td>
</tr>
<tr>
<td>apetito (in-company)</td>
<td>Manufacture; Filling</td>
<td>CI scheme and step-by-step improvements to cut energy use and GHG emissions</td>
<td>GHG, Energy</td>
<td>Emissions cut by 11% over 2 years; factory energy use alone cut by 14% in 1 year</td>
<td>VA (FDF Five-fold Environmental Ambition); trade association support</td>
<td>(7) (2010)</td>
<td></td>
</tr>
<tr>
<td>Unidentified (in-company)</td>
<td>Manufacture; Filling</td>
<td>CI used by large chilled foods maker to improve productivity, reduce waste</td>
<td>Waste</td>
<td>n/a</td>
<td>External support (consultants)/dedicated ‘CI manager’; financial drivers; senior management engagement; procurement pressure</td>
<td>Frequent product changes leading to ‘reactivity’</td>
<td>(DE004) (2011)</td>
</tr>
<tr>
<td>Unidentified (in-company)</td>
<td>Manufacture; Filling</td>
<td>Kaizen considered element of TPM system developed by large drinks manufacturer</td>
<td>Various</td>
<td>n/a</td>
<td>EMS; regulatory compliance; financial drivers; external support (consultants)</td>
<td></td>
<td>(DE013) (2011)</td>
</tr>
<tr>
<td>United Biscuits (in-company)</td>
<td>Manufacture; Filling</td>
<td>Focus on CI and employee engagement to achieve incremental change</td>
<td>Waste, Water</td>
<td>18% cut in food waste in first 8 months of 2008 vs. same period in 2007; water use cut by 28% between 2007 &amp; 2009; 17% water use cut in 2008</td>
<td>Positive culture; staff engagement; VA (FDF Five-fold Environmental Ambition); trade association support</td>
<td>(19) (2008); (8) (2009); (7) (2010)</td>
<td></td>
</tr>
<tr>
<td>Burtons (in-company)</td>
<td>Manufacture; Filling</td>
<td>Focus on CI and employee awareness of energy efficiency</td>
<td>Energy, GHG</td>
<td>1.322 ktCO₂ eq savings (10%) between 1999 and 2007</td>
<td>‘Culture’; staff engagement; VA (FDF Five-fold Environmental Ambition); trade association support</td>
<td></td>
<td>(19) (2008);</td>
</tr>
<tr>
<td>Walkers (in-company)</td>
<td>Manufacture; Filling</td>
<td>Water use at each site reviewed and cut, ‘water champions’ appointed</td>
<td>Water</td>
<td>42% cut in water use</td>
<td>‘Culture’; staff engagement &amp; champions; VA (FDF Five-fold Environmental Ambition, FHC); trade association support; investment</td>
<td></td>
<td>(19) (2008); (8)</td>
</tr>
<tr>
<td>Britvic (in-company)</td>
<td>Manufacture; Filling</td>
<td>Water consumption managed</td>
<td>Water</td>
<td>n/a</td>
<td>‘Culture’; staff engagement &amp; champions; VA (FDF Five-fold Environmental Ambition); trade association support</td>
<td></td>
<td>(19) (2008)</td>
</tr>
<tr>
<td>Company</td>
<td>Sector(s) impacted</td>
<td>Description</td>
<td>Target resources</td>
<td>Savings</td>
<td>Drivers/ Facilitators</td>
<td>Barriers (if specified)</td>
<td>Source (Year)</td>
</tr>
<tr>
<td>-------------------</td>
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<td>--------------------------------------------------------------------------------------</td>
<td>--------------------------</td>
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</tr>
<tr>
<td>Hazeldene</td>
<td>Manufacture; Filling</td>
<td>Awareness and ‘turn off’ campaigns and £15k on engineering solution</td>
<td>Water</td>
<td>20% cut in water use (equivalent to 70,000 m³/yr)</td>
<td>staff engagement; VA (FHC); investment</td>
<td></td>
<td>(8) (2009)</td>
</tr>
<tr>
<td>Dairy Crest</td>
<td>Manufacture; Filling</td>
<td>Awareness raising and 'utility champions'</td>
<td>Water</td>
<td>6% cut in water use between 2006 and 2007</td>
<td>'Culture'; staff engagement and champions; VA (FDF Five-fold Environmental Ambition); trade association support; investment</td>
<td></td>
<td>(19) (2008)</td>
</tr>
<tr>
<td>Three fish</td>
<td>Manufacture; Filling</td>
<td>Waste prevention reviews to minimise water use and development of interventions to reduce use</td>
<td>Water</td>
<td>n/a</td>
<td>External support (Envirowise)</td>
<td></td>
<td>(20) (2011)</td>
</tr>
<tr>
<td>processors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fox's Biscuits</td>
<td>Manufacture; Filling</td>
<td>Kaizen-like events used to improve operation equipment effectiveness (OEE) and cut waste</td>
<td>Waste</td>
<td>74% to 85% inc in OEE; waste cut by 26%</td>
<td>External support (Suiko consultants); staff engagement &amp; training</td>
<td></td>
<td>(21)</td>
</tr>
<tr>
<td>SADAFCO</td>
<td>Manufacture; Filling</td>
<td>CI practices rolled out across all areas</td>
<td>Waste</td>
<td>n/a</td>
<td>External support (Suiko consultants); staff engagement &amp; training</td>
<td></td>
<td>(21)</td>
</tr>
<tr>
<td>Unidentified</td>
<td>Manufacture; Filling</td>
<td>Kaizen event to improve production at snack factory</td>
<td>Waste</td>
<td>50% increase in output; 40% improvement in efficiency across site; waste cut by 35%</td>
<td>External support (Newton Europe); staff engagement</td>
<td></td>
<td>(22)</td>
</tr>
<tr>
<td>Wilson’s Country</td>
<td>Manufacture; Filling</td>
<td>CI at potato processor with NISP support</td>
<td>Waste, Water, GHG</td>
<td>1.22 ktCO₂e cut, 250 t waste diverted from landfill, 250t raw materials saved</td>
<td>External support (NISP)</td>
<td></td>
<td>(23)</td>
</tr>
</tbody>
</table>
4.2 Measurement

4.2.1 Sector and multi-sector initiatives

Stimulating companies to commit to Continuous Improvement on a sector level is an important first step to increasing resource efficiency in the food and drink sector. Measuring is an important second step, which is promoted in different ways throughout the industry. A consultant offering Lean training to the UK food and drink sector reports that very few companies are currently performing this seemingly simple task: “Many big companies don’t even know how much food and packaging waste they are generating”. He adds that the measures “need to be properly aligned, user-friendly, meaningful, balanced”. Such measures should include throughput, levels of efficiency, costs including of labour and materials, customer complaints, safety, and so on. The measures then need to be reviewed “hourly, daily, weekly and monthly”. Understanding the variance in a process is vital (DE010).

This opinion was reinforced by another consultant who claimed that many of his clients simply didn’t measure properly. He gave the example of a company making 3,000 types of food product for airlines which “did not know which products were making them money and which weren’t. They were ending up promoting the wrong ones - destroying their business” (DE014).

On a sector and multi-sector level, several supported initiatives have come into existence over the past years that explicitly improve the measurement of different environmental indicators within food and drink manufacturing. Examples of sector-level initiatives that directly improved measurement in different food and drink manufacturing sectors include:

- The Industrial Energy Efficiency Accelerator has started in a number of areas such as the industrial bakery, brewing, confectionery stoving, dairy and maltings sectors, installing sub-meters to accurately measure energy consumption in these sectors (11).
- In its 2010 environmental strategy report, the Scotch Whisky Association provides baseline data on a number of environmental indicators, indicating that increased measurement is in the process of being implemented (11).
- In May 2008 the dairy supply chain published the Dairy Roadmap, setting targets for 2010, 2015 and 2020. Manufacturers have been gathering data on a number of environmental metrics such as energy use, greenhouse gas emissions, packaging and waste (12). In 2009, the Dairy Roadmap progress report provided baseline data from 60% (by volume) of UK processors. In 2010, data were collected from 47 sites, covering 70% of UK processing as measured by milk volume (24).

The systematic measurement of resource use or other environmental indicators can be facilitated by these high level initiatives. The direct results of these initiatives are difficult to estimate, but the more information sectors accrue the more potential there is for making targeted environmental improvement. Sectors where measuring has been commonplace for a long time, such as the brewing sector, seem to more easily generate environmental improvements in the wake of voluntary agreements.

4.2.2 Company initiatives

Increased metering is also a part of many of individual companies’ strategies to improve environmental performance. The literature shows a clear bias toward mentioning the implementation of water metering and measuring; it rarely reports increased measuring of waste, energy or emissions. The emphasis on water may be due to:

- There is a recent Agency focus on water use reduction.
- Measuring of waste has historically been important for Waste Regulations, and is therefore not explicitly reported in recent literature.
- Energy is a more valuable resource than water and has for a long time been included in more in-depth measuring practices.
• Measuring emissions is difficult, involving estimating emissions as a result of energy use, and end-of-pipe metering practices that are not very well established.

Despite this narrow focus of the literature, a number of interesting company initiatives have been identified that show the value of increased metering to improving environmental performance:

• At apetito frozen foods, water use has been reduced since 2007 through water use monitoring and continuous improvement (7).
• At Mars, additional water metering led to improvements of 8% in water use over the course of 2009 (7).
• The 2009 Federation House Commitment progress report reports the actions taken by the William Jackson Food group toward decreasing water use, which includes the frequency of water monitoring and improving the accuracy of metering by installing sub-meters (8).
• This same report states that the basis of achieving the 42% reduction in water use at Walkers was the gathering of robust data on usage and establishing metering in key lines (8).
• Cranswick plc took a similar approach to speed up water reduction, appointing and training water champions at each of its sites. This equipped them with the skills to carry out a comprehensive water mass balance analysis which has formed the benchmark against which subsequent reductions will be measured (8). This shows that employee engagement is important, again placing company-wide behavioural changes at the centre of implementing Lean-like environmental reduction tools.
• The potato processor Greenvale managed to reduce water use by 20% in 2008 by finding water reduction savings opportunities after sub-metering at its sites (8).
• Dairy Crest performed a metering exercise across all sites and was able to identify one plant where water use per volume of milk was significantly higher than on its other sites. Within these sites a review of equipment was carried out, identifying that the bottle washers were using significantly more water than they were designed to do. When the jet bars were replaced, water use was reduced by 5,500 m$^3$ per month (on a like for like production volume), equating to 66,000 m$^3$ per year water and effluent savings. A reduction in steam use of 166 tonnes per week was also achieved, with the total savings estimated at £200k per year (8). Dairy Crest’s site at Severnside in Gloucestershire generates daily departmental usage reports on water use (19).

There were few examples of increased measuring of other environmental impacts:

• Much of the progress at Kellogg’s can be put down to good housekeeping, installing 86 new meters to accurately monitor its use of electricity, gas and steam to potentially identify inefficiencies (17).
• Alpro, a producer of soya-based food and drink, has committed to a process of becoming carbon neutral by 2020, and has therefore started metering the carbon footprint of products on its Kettering site. An action that resulted from this increased metering is that it modified sterilisers at this site, leading to an emission reduction of 30% from fossil fuel consumption in 2007 (19).
• The single example in the literature of an increase in sub-metering packaging waste was from the operational improvement consultancy Newton Europe, who completed a two month project for a cake manufacturer, reducing packaging waste by 35% through understanding the causes of waste at different points on the line. Transfer of the Newton methodology to the local team led to the team continuing to measure packaging waste at key points on the line and further driving down waste (25).

Again much of the evidence for measuring takes the form of within-company ‘waste minimisation-type’ activity.

*Table 43* summarises the evidence for measurement in the food manufacturing & filling sector.
### Table 43: Evidence for measurement

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/ Facilitators</th>
<th>Barriers (if spec’d)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various</td>
<td>Manufacture; Filling</td>
<td>Sub-meters installed in bakery, brewing, dairy, confectionery stowing &amp; maltings sectors to measure energy consumption</td>
<td>Energy, GHG</td>
<td>n/a</td>
<td>External support (Industrial Energy Efficiency Accelerator)</td>
<td>(27); (28); (29); (30); (10); (2011)</td>
<td></td>
</tr>
<tr>
<td>Various</td>
<td>Manufacture; Filling</td>
<td>Baseline indicator data provided by Scotch Whisky Association</td>
<td>Various</td>
<td>n/a</td>
<td>Trade association support</td>
<td>(11) (2010)</td>
<td></td>
</tr>
<tr>
<td>Various</td>
<td>Manufacture; Filling</td>
<td>Data gathered by manufacturers representing up to 70% by volume of UK milk processing</td>
<td>Energy, GHG, Packaging, Waste</td>
<td>n/a</td>
<td>VA (Dairy Roadmap); external support (Defra funding)</td>
<td>(12) (2009); (24)</td>
<td></td>
</tr>
<tr>
<td>apetito</td>
<td>Manufacture; Filling</td>
<td>Water use reduced since 2007 through monitoring and CI</td>
<td>Water</td>
<td>n/a</td>
<td>VA (FDF Five-fold Environmental Ambition); trade assn support</td>
<td>(7) (2010)</td>
<td></td>
</tr>
<tr>
<td>Mars</td>
<td>Manufacture; Filling</td>
<td>Water metering</td>
<td>Water</td>
<td>8% cut in water use in 2009</td>
<td>VA (FDF Five-fold Environmental Ambition); trade assn support</td>
<td>(7) (2010)</td>
<td></td>
</tr>
<tr>
<td>William Jackson Food Group</td>
<td>Manufacture; Filling</td>
<td>Water monitoring and sub-meters</td>
<td>Water</td>
<td>n/a</td>
<td>VA (FHC); staff engagement</td>
<td>(8) (2009)</td>
<td></td>
</tr>
<tr>
<td>Walkers</td>
<td>Manufacture; Filling</td>
<td>Water metering</td>
<td>Water</td>
<td>42% reduction in water use</td>
<td>VA (FHC); staff engagement</td>
<td>(8) (2009)</td>
<td></td>
</tr>
<tr>
<td>Cranswick</td>
<td>Manufacture; Filling</td>
<td>Water champions appointed and trained to conduct water mass balance analysis</td>
<td>Water</td>
<td>n/a</td>
<td>VA (FHC); staff engagement &amp; training, champions</td>
<td>(8) (2009)</td>
<td></td>
</tr>
<tr>
<td>Greenvale</td>
<td>Manufacture; Filling</td>
<td>Sub-metering at sites</td>
<td>Water</td>
<td>Water use cut by 20% in 2008</td>
<td>VA (FHC); staff engagement</td>
<td>(8) (2009)</td>
<td></td>
</tr>
<tr>
<td>Dairy Crest</td>
<td>Manufacture; Filling</td>
<td>Metering exercise all sites; water jet bars replaced</td>
<td>Water</td>
<td>water use cut 66,000 m³/yr (water &amp; effluent); steam use cut 166 t/wk; total savings c.£200k/yr</td>
<td>VA (FDF Five-fold Environmental Ambition; FHC); staff engagement; trade assn support; technological investment</td>
<td>(19) (2008); (8) (2009)</td>
<td></td>
</tr>
<tr>
<td>Kellogg’s</td>
<td>Manufacture; Filling</td>
<td>86 new meters installed to monitor electricity, gas and steam</td>
<td>Energy, Water</td>
<td>n/a</td>
<td>CSR</td>
<td>(17) (2008)</td>
<td></td>
</tr>
<tr>
<td>Alpro</td>
<td>Manufacture; Filling</td>
<td>Carbon footprint of products on Kettering site; sterilisers modified</td>
<td>Energy, GHG</td>
<td>30% cut in fossil fuel consumption in 2007</td>
<td>VA (FDF Five-fold Environmental Ambition); staff engagement; trade assn support; technological investment</td>
<td>(19) (2008); (2009)</td>
<td></td>
</tr>
<tr>
<td>Unidentified</td>
<td>Manufacture; Filling</td>
<td>Sub-metering of packaging waste at cake maker</td>
<td>Waste, Packaging</td>
<td>Packaging waste cut by 35%</td>
<td>External support (Newton Europe); staff engagement</td>
<td>(25)</td>
<td></td>
</tr>
</tbody>
</table>
## 4.3 KPIs & Targets

Table 44 summarises the evidence for the use of KPIs and targets in the food manufacturing and filling sector.

**Table 44: Evidence for KPIs and targets**

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB World Foods (in-company)</td>
<td>Manufacture; Filling</td>
<td>Environmental KPIs implemented</td>
<td>Various</td>
<td>n/a</td>
<td>VA (FDF Five-fold Environmental Ambition); trade association support</td>
<td></td>
<td>(7) (2010)</td>
</tr>
<tr>
<td>Campbell Soup Company (in-company)</td>
<td>Manufacture; Filling</td>
<td>Balanced scorecard tracking and reporting of emissions from facilities and operators</td>
<td>GHG</td>
<td>n/a</td>
<td>CSR</td>
<td></td>
<td>(32) (2011)</td>
</tr>
<tr>
<td>R&amp;R Ice Cream (in-company)</td>
<td>Manufacture; Filling</td>
<td>Environmental KPIs for water efficiency and effluent load, targeting 5% reduction</td>
<td>Water</td>
<td>n/a</td>
<td>VA (FHC); staff engagement</td>
<td></td>
<td>(8) (2009)</td>
</tr>
<tr>
<td>United Biscuits (in-company)</td>
<td>Manufacture; Filling</td>
<td>90% waste recycling rate, and a 10% cut in waste generation targeted</td>
<td>Waste</td>
<td>n/a</td>
<td>Positive culture; staff engagement; VA (FDF Five-fold Environmental Ambition); trade association support</td>
<td></td>
<td>(19) (2008)</td>
</tr>
<tr>
<td>Müller Dairy (in-company)</td>
<td>Manufacture; Filling</td>
<td>Target to cut waste to landfill by 66% by 2011 (against 2007 baseline); and zero waste to landfill by 2015</td>
<td>Waste</td>
<td>n/a</td>
<td>VA (FDF Five-fold Environmental Ambition); trade association support</td>
<td></td>
<td>(7) (2010)</td>
</tr>
<tr>
<td>Unidentified (in-company)</td>
<td>Manufacture; Filling</td>
<td>Supplier of egg products established targets</td>
<td>Waste</td>
<td>Waste costs cut by £1m/yr</td>
<td>EMS</td>
<td></td>
<td>(DE042) (2011)</td>
</tr>
<tr>
<td>Various (supply chain)</td>
<td>Manufacture; Filling</td>
<td>Suppliers to large retailer asked to commit KPIs, tracked on balanced scorecard</td>
<td>Various</td>
<td>n/a</td>
<td>Procurement pressure; positive attitudes (in SMEs); external support (consultant; Skills Councils funding)</td>
<td>Language of Lean; perceived costs (of consultants); uncertainty over longevity of results; crisis management culture</td>
<td>(DP001) (2011)</td>
</tr>
</tbody>
</table>
4.4 **Value Stream Mapping**

VSM is a tool to enable visualisation of material and information flows required to make a product, to differentiate those processes that add value from those that merely incur costs. According to one expert interviewed for this project, who had been involved in the Food Chain Centre programme described below, simple walks through workplaces and the use of VSM and Process Mapping of end-to-end supply chains could be “hugely powerful”. He believed this could be more important than training people to become “black belts in 6 Sigma” (DE002).

VSM can be applied to visualise processes within a manufacturing site, or to visualise processes within a complete value chain – the latter being a good example of a ‘clean operations-type’ activity. Depending on the waste saving opportunities identified, these exercises can lead to the use of many of the tools elaborated upon above. Some examples are provided in this Section.

4.4.1 **Sector-level VSM**

Between 2002 and 2008, the Defra-funded Food Chain Centre completed nine whole-chain projects in the red meat industry and eight in the dairy industry, to test whether there is value in the application of Lean in these industries. These projects commenced with an exercise to make a value stream of the chains (Figure 89 provides an example).

In the eight dairy chains, a number of actions were typically taken to reduce wasteful activity (34):

- reducing information complexity through VSM of the whole chain
- improving demand management to move toward just-in-time delivery
- introducing overall supply-chain KPIs
- developing a better understanding of customer value to eliminate wasteful processes.

In the red meat industry, it transpired that the amount of product lost in manufacturing depends on the species, but is largely due to trimming operations, out-of-specification product, and packaging defects. A number of wasteful activities were identified and a set of KPIs developed to provide a focus for improving performance. For example, overall equipment effectiveness (OEE) in the companies in the study varied between 26% and 40%, where world class performance is 85% (33) (35). Step-wise improvement toward best practice was deemed vital to reduce unnecessary waste.

*Table 45* provides an example of targets and KPIs of one such chain, adapted to reflect areas where there are savings opportunities in the manufacturing of cheese.
Figure 89: Current state map of a dairy value chain

Table 45: Example of a set of supply chain indicators in a cheese chain

<table>
<thead>
<tr>
<th>Whole chain performing measures</th>
<th>Current state</th>
<th>Future state targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total lead-time (excluding maturation)</td>
<td>34</td>
<td>20</td>
</tr>
<tr>
<td>Lead-time from maturation to consumer</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>Value adding % time</td>
<td>0.6%</td>
<td>1%</td>
</tr>
<tr>
<td>Total number of steps</td>
<td>176</td>
<td>100</td>
</tr>
<tr>
<td>% of value adding steps</td>
<td>7%</td>
<td>12%</td>
</tr>
<tr>
<td>Days of inventory</td>
<td>31</td>
<td>15</td>
</tr>
<tr>
<td>Right first time product quality %</td>
<td>90.5%</td>
<td>95%</td>
</tr>
<tr>
<td>Total % wastage</td>
<td>1.7%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Plant travel distance</td>
<td>1886 m</td>
<td>1000 m</td>
</tr>
</tbody>
</table>

Source: (34) adapted by Oakdene Hollins
Although no actual savings data specific to the dairy and red meat chains resulting from these actions are published in the Dairy Report, the savings opportunities are stated to be substantial, and an expert involved in the Food Chain Centre claims that the programme as a whole “realised £14m in savings, equating to a three-fold rate of return on investment”. Unfortunately, he, too, was unable to relate savings to specific measures (DE002).

4.4.2 Site-specific VSM

Improvements can also be made by carrying out VSM exercises within sites at the level of a production line.

A representative from a major UK food manufacturer mentioned that his company uses various mapping tools: VSM and End-to-End Supply Chain Mapping in particular to develop a ‘Current State Map’. This work assists with the tricky issue of demand forecasting. The interviewee noted that the use of such approaches has been driven by the retailer M&S across entire supply chains, although his company uses them unilaterally as well – typically with the support of ‘operational effectiveness consultants’ hired in for short periods (DE004). One such consultant interviewed for this project reinforced the importance of mapping: “When we go into a company we always try to map - on one page - exactly where all the yield losses occur across all the business: you need that visibility” (DE025).

A case study of a Food Chain Centre operations master-class describes how an apple packing plant operated by Adrian Scripps Ltd was able to eliminate a step in the production process of its packing line after conducting a value stream mapping exercise. The visual representation of the production line resulting from this mapping exercise is provided in Figure 90. After this mapping exercise, Adrian Scripps was able to make savings through lower inventory management, in effect moving toward just-in-time delivery. This led to the current situation, in which it continuously monitors its processes and has significantly improved workplace organisation, signifying the application of 5S practices. It also developed a plan to cover the next six priority areas, taking a kaizen approach. The direct benefits from this exercise are stated to be:

- Elimination of the tray pre-lining process, releasing labour plus time saving from lower inventory.
- Establishment of performance monitoring boards that are now used as a focal point for regular company briefing and communications.
- Provision of detailed visual work instructions for key processes with an integrated training plan.
- Improved workplace organisation and development of a plan to cover the next six priority areas (36).
Figure 90: Visual representation of a packaging line in an apple packaging plant

The Food Chain Centre also assisted in improving the efficiency of Humber VHB Ltd, whose packaging plant supplies herbs to Tesco. After a visual representation of the complete process was made, the team in the plant decided to focus on improving the ‘not right first times’ and overall equipment effectiveness, and on decreasing downtime of the machines. To improve communication and provide feedback on cost, quality and delivery issues, the team created an information board as part of its drive to embed the learning from this master-class more widely to create a culture of continuous improvement. People productivity has increased by 18% from 160 to 190 packs per person-hour (37).

Other examples include:

- A VSM exercise at a dairy company that produces yoghurt and its derivatives identified a process which, upon elimination, could result in a 20% reduction of CO₂ emissions (6).
- A thorough review of packaging at AB World Foods identified light-weighting as a significant opportunity, resulting in a 12% reduction in glass weight used per year, with the extra benefit of using 20 fewer lorries per year (7).

One Lean consultant described how he visited an SME pork pie manufacturer and offered advice on how to change the layout by “doing VSM, flow process and the 7 Wastes”. He claimed that the savings opportunities would represent a “100% improvement” (DE039).

A final example of VSM is provided by a Lean consultant interviewed for this project who described how after designing a “desired future state” with his clients (e.g. “let’s go from 40% to 70% productivity”) he will seek “to operationalise the strategy” by using a detailed VSM procedure: “a way of visualising the
whole process”. A key step is “to identify barriers to flow – because Lean is all about flow”. The interviewee reported that several other Lean techniques are used in conjunction with VSM, including OEE (“about assets’ capability and performance”), Synchronised Pull (“to minimise work in progress”), TPM (“about assets management”), SMED (for “changeovers”) and a Kanban system (DE035). Unfortunately, no savings data were available at the time of writing.

Table 46 summarises evidence for the use of VSM in the food manufacturing and filling sector.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/ Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various (supply chain)</td>
<td>Agriculture; Manufacture; Filling Distribution; Retail</td>
<td>Development by the Food Chain Centre (2002 – 2007) of ‘current’ and ‘ideal state maps’ to improve efficiency of 4 largest UK agricultural sectors</td>
<td>Waste</td>
<td>Whole programme realised £14 M savings</td>
<td>External support (Defra funded FCC; coordinated by IGD); Collaborative approach; financial drivers</td>
<td>Limited senior mgmt time; negative attitudes</td>
<td>(38) (2007); (39) (2007); (DE002) (2011); (33) (2011); (34) (2011); (35) (2011)</td>
</tr>
<tr>
<td>Unidentified (supply chain)</td>
<td>Manufacture; Filling</td>
<td>VSM and End-to-End Supply Chain Mapping tools used for demand forecasting driven by multiple retailer</td>
<td>Waste</td>
<td>n/a</td>
<td>Procurement pressure; external support (consultants); senior management engagement; supply chain visibility</td>
<td>Frequent product changes leading to ‘reactivity’</td>
<td>(DE004) (2011)</td>
</tr>
<tr>
<td>Adrian Scripps (in-company)</td>
<td>Filling</td>
<td>Apple packing plant conducted VSM, moving to lower inventory management and just-in-time delivery</td>
<td>Waste</td>
<td>n/a</td>
<td>External support (Defra funded FCC; coordinated by IGD)</td>
<td></td>
<td>(36) (2007)</td>
</tr>
<tr>
<td>Humber VHB (in-company)</td>
<td>Filling</td>
<td>Efficiency of herbs packaging plant improved through visual representation of process</td>
<td>Cost &amp; Time</td>
<td>productivity increased by 18% to 190 packs/person-hour</td>
<td>External support (Defra funded FCC; coordinated by IGD); communication and staff engagement</td>
<td></td>
<td>(37) (2007)</td>
</tr>
<tr>
<td>Unidentified (in-company)</td>
<td>Manufacture; Filling</td>
<td>VSM exercise at dairy company identified process to cut GHG emissions</td>
<td>GHG</td>
<td>20% cut in emissions (identified)</td>
<td>Financial drivers</td>
<td></td>
<td>(6) (2010)</td>
</tr>
<tr>
<td>AB World Foods (in-company)</td>
<td>Manufacture; Filling</td>
<td>Packaging review identified light-weighting as opportunity</td>
<td>Raw materials</td>
<td>12% cut in glass used/yr; 20 fewer lorries/yr</td>
<td>VA (FDF Five-fold Environmental Ambition); trade association support</td>
<td></td>
<td>(7)</td>
</tr>
<tr>
<td>Unidentified (in-company)</td>
<td>Manufacture; Filling</td>
<td>VSM and ‘the 7 wastes’ informed potential change in layout at pork pie manufacturer</td>
<td>Cost &amp; Time</td>
<td>“100% improvement” (identified)</td>
<td>External support (consultant)</td>
<td></td>
<td>(DE039) (2011)</td>
</tr>
<tr>
<td>Unidentified (in-company)</td>
<td>Manufacture; Filling</td>
<td>VSM procedure along with OEE, TPM, SMED and Kanban system</td>
<td>Waste, Cost</td>
<td>n/a</td>
<td>External support (consultant)</td>
<td>Senior mgmt resistance/ impatience</td>
<td>(DE035) (2011)</td>
</tr>
</tbody>
</table>
4.5 Advanced Tools

Some examples of advanced tools in food and drink manufacturing identified in the literature review are developed in this Section. Other examples can be seen as the result of a VSM exercise and are therefore described in the previous Section.

Examples of advanced Lean or Lean-like tools in the published literature are sparse. This is likely due to the limited audience for the processes behind environmental improvements. Some examples include:

- Ginsters, producer of Cornish pasties and other ready-to-eat products, is applying SMED techniques to reduce downtime and increase efficiency at product changeovers. Through SMED training, the manufacturer has been able to realise step-change improvement in line utilisation (40).
- 5S is being used by Samworth Brothers’ chilled foods (Ginsters’s parent company) to provide staff with a framework to contribute to environmental improvements in its own operations (40).
- An Envirowise good practice guide shows that at C. Shippam Ltd, a manufacturer of spreadable goods and canned ready meals, a problem with overfills was solved using a set of statistical techniques. Regulation states that under-fills can only drop below 94% of the label weight 2.5% of the time and no product can drop below 88% of the label weight. For this reason, targets for filling were set on the high-end to ensure products would never be rejected on the basis of under-filling. A history of mean fill values and standard deviations was used to relate filling line effects to upstream process causes. Over six months, the standard deviation of the filling line was reduced from >1g to <0.3g (41).
- One of the ways in which Müller Dairy has reduced waste was by improving its forecast methodology and accuracy (7). By doing this it is effectively moving toward just-in-time production and is obtaining a ‘handle’ for decreasing the amount of downtime of machines.

Rather more evidence of the use of advanced Lean tools and techniques was identified during stakeholder interviews. For instance, a representative of a major international drinks manufacturer reported that his company uses a highly formal system known as Total Productive Maintenance (TPM) which “is all about maximising efficiency of all resources – human, capital, plant, ingredients ... It encompasses many of the Lean tools such as kaizen, SMED, and so on ... TPM is our ‘operating mantra’” (DE008). Another manager at the same firm explained that TPM consisted of several ‘pillars’ including “planned maintenance, focused improvement, machinery set up, safety and training/education.” All the pillars had to be in place for TPM to work. The interviewee reported that, at the moment “TPM doesn’t have an environmental pillar, although one might be developed in the future.” According to this interviewee, no quantitative evidence of the effectiveness of the TPM approach was yet available: “it’s too early to tell, we would have to wait another two to three years.” The manager had raw data for specific environmental variables such as water, but was not comfortable divulging these in case "incorrect assumptions" were drawn; for instance, factors other than TPM could be determining these variables (DE013).

5S was a tool cited by an interim project manager in the food manufacturing sector interviewed for this project. During training exercises run by an external consultancy, and in which the interviewee participated, “5S was an important first technique that employees were taught ... Playing games with this tool was a really good way to overcome resistance to change.” Savings from the application of 5S at the company were not reported, however (DE011). 5S was also regarded as important by a different interviewee who works as an interim manager for food businesses: “Once buy-in is achieved, the next step has to be implementing 5S, ‘a place for everything and everything in its place.’” He gave an impressive example from work conducted at a food manufacturing site in the northeast of England which was “trying to get former miners and steelworkers to make ready meals. When I joined the company it claimed to be 6Sigma accredited but it wasn’t even doing 5S.” The interviewee went on to describe how he introduced Lean manufacturing to the business by sending all 550 people onto an NVQ1 & 2 course, with the RDA One North East providing £480k in funding. Training support also came from a Lean expert at the Nissan factory in Sunderland. The net result was an increase in output “from 800,000 meals per
annum to 1.1-1.2m per annum putting 1.5% on the bottom line.” Part of the secret, the interviewee reported, was “to put together a small team of six people – one from each department” which were then rotated “so no one had any fixed ideas” (DE026). Interestingly, VSM was also praised by a member of the delivery body MAS for the opportunity it offered to “bring in people from different parts of the business who may not normally talk to each other” (DE038).

A manager responsible for Operational Excellence (OE) at a manufacturing site for two well-known drinks brands reported that he used a blend of tools to reduce inventory and improve operational performance, and for innovative problem solving; “It’s about longer term strategic thinking, asking where do we want to be?” Some of the techniques mentioned include “a Russian problem-solving tool called TRIZ” and an approach called “‘idealized design’ or ‘ideation’ – getting in the mind of the customer, asking what do they want?” The manufacturer had also recently overseen “a Value Engineering Exercise” wherein every element of the physical product was assessed “to determine how much value to the customer it truly adds: bottle, cap, label, sleeves, presentation, colour, weight, and so on.” The aim was to identify which elements of the product could be adjusted to “delight” the customer. For solving ‘root cause problems’, the manager says he uses a DMAIC (Design, Measure, Analyse, Improve, Control) approach. According to this interviewee, his company has “taken £47m out of the supply chain through Lean interventions including packaging lightweighting, changes to label sizes and caps, and so on.” Asked what the investment was, he replied that it was simply the cost of a Masters course he had taken on Lean manufacturing (DE033).

A former senior Lean engineer at a major automotive company, now operating a VSE in the food sector, argued that some of the more advanced Lean tools such as 6Sigma are just “too bureaucratic” for smaller companies. She felt that the important thing was to use “common sense to streamline processes” (DE005). Similarly, a representative of a large international consultancy reported that “certain tools are better for bigger operations, such as 5S: I wouldn’t advise a small company to use it” (DE028).

As the preceding paragraphs suggest, much of the emphasis on advanced tools takes the form of ‘waste minimisation-type’, in-company activities.

Table 47 summarises the evidence for the use of advanced tools in the food manufacture and filling sector.
### Table 47: Evidence for advanced tools

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/ Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ginsters (in-company)</strong></td>
<td>Manufacture; Filling</td>
<td>SMED techniques used</td>
<td>Waste, Time</td>
<td>n/a</td>
<td></td>
<td>Site constraints</td>
<td>(40) (2004); a (2012)</td>
</tr>
<tr>
<td><strong>Samworth Brothers (in-company)</strong></td>
<td>Manufacture; Filling</td>
<td>5S provide staff with framework to contribute to environmental improvement</td>
<td>Various</td>
<td>n/a</td>
<td>Staff engagement</td>
<td></td>
<td>(40) (2004)</td>
</tr>
<tr>
<td><strong>C. Shippam (in-company)</strong></td>
<td>Manufacture; Filling</td>
<td>Overfills solved using statistical techniques</td>
<td>Raw materials</td>
<td>n/a</td>
<td>External support (Envirowise)</td>
<td>Regulation (encouraging overfill)</td>
<td>(41)</td>
</tr>
<tr>
<td><strong>Müller Dairy (in-company)</strong></td>
<td>Manufacture; Filling</td>
<td>Improvement of forecast methodology</td>
<td>Waste</td>
<td>n/a</td>
<td>VA (FDF Five-fold Environmental Ambition); trade association support</td>
<td></td>
<td>(7) (2010)</td>
</tr>
<tr>
<td><strong>Unidentified (in-company &amp; supply chain)</strong></td>
<td>Manufacture; Filling</td>
<td>Drinks manufacturer uses TPM</td>
<td>Waste, Water, Energy</td>
<td>n/a</td>
<td>EMS; regulatory compliance; financial drivers; staff engagement; senior management engagement; external support (consultants)</td>
<td></td>
<td>(DE008) (2011); (DE013) (2011)</td>
</tr>
<tr>
<td><strong>Unidentified (in-company)</strong></td>
<td>Manufacture; Filling</td>
<td>5S used</td>
<td>Various</td>
<td>n/a</td>
<td>External support (consultant)</td>
<td>Resistance to change</td>
<td>(DE011) (2011)</td>
</tr>
<tr>
<td><strong>Unidentified (in-company)</strong></td>
<td>Manufacture; Filling</td>
<td>5S used at a food manufacturing site in the northeast of England</td>
<td>Waste, Time</td>
<td>Output increased from 800k meals/yr to 1.1-1.2m/yr; 1.5% inc in profit</td>
<td>Staff engagement &amp; training; effective communication; external support (One North East; Lean expert from Nissan)</td>
<td></td>
<td>(DE026) (2011)</td>
</tr>
<tr>
<td><strong>Unidentified (in-company &amp; supply chain)</strong></td>
<td>Manufacture; Filling</td>
<td>Blend of tools to reduce inventory and improve operational performance at a drinks company (e.g. TRIZ, Value Engineering Exercise, DMAIC); changes to packaging and logistics followed</td>
<td>Energy, Raw materials, Waste</td>
<td>£47m saved across supply chain</td>
<td>Financial drivers (esp reducing fuel bills); external support (consultants)</td>
<td>Senior management resistance</td>
<td>(DE033) (2011)</td>
</tr>
</tbody>
</table>

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WRAP. Production Ready Packaging: A review of the opportunity for production ready packaging in the UK food and drink sector. Written by Oakdene Hollins Ltd. Forthcoming.
4.6 **Mixed Tools**

One good example of the use of a combination of tools comes from a WRAP-initiated series of one-to-one collaborations between five major UK retailers (Musgrave, Sainsbury’s, Morrisons, Tesco and Marks & Spencer) and specific suppliers (United Biscuits, World Flowers, Kerry-Noon, MM (UK), Natures Way Foods, and UNIQ). A mixture of Lean-type tools and approaches were used - including ‘mind-mapping’, ‘KPI information gathering’, ‘end-to-end supply chain walk-through’ and ‘process mapping’ - to cut food (and floral) waste arisings in the supply chains. The work (coordinated by IGD) ran from December 2009, and by March 2011 had prevented c.1.4kt of waste arising; a further 1.193 kt was expected to be prevented in 2011-12. In total, this equates to a 1% reduction in waste as a percent of sales, although at the outset, sustained behaviour change was considered as important as a waste reduction target. *(ID412)*

The work, which WRAP describes as ‘the first of its kind designed specifically to involve trading partners working together to identify and prevent waste in their supply chains’, is designed to support and encourage signatories in meeting the CC2 target of a 5% reduction in product and packaging waste (both solid and liquid) in the grocery supply chain. *(ID412)*

Table 48 summarises the evidence for the use of mixed tools in the food manufacturing & filling sector.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various (supply chain)</td>
<td>Retail; Manufacture; Filling</td>
<td>Collaborations between five major UK retailers and suppliers to cut waste. Lean tools including measurement, KPIs, and process mapping</td>
<td>Waste</td>
<td>Between Dec 2009 &amp; March 2011, c.1.4kt waste prevented; further 1.193kt cut expected in 2011-12; equates to a 1% overall waste reduction</td>
<td>External support (WRAP, IGD); staff engagement &amp; senior mgmt buy-in (financial driver)</td>
<td><em>(ID412)</em></td>
<td></td>
</tr>
</tbody>
</table>
5 Behavioural Considerations

5.1 Attitudes

For Lean thinking to be successful in a manufacturer, a favourable company-wide ‘culture’ seems to be important. This has been stressed by, for instance, United Biscuits which found that a positive attitude among its employees enabled the company to achieve many of its “new green goals” on water use and waste launched in 2008 (7) (8). Similarly, a leading manufacturer of breakfast cereals described how everyone in the company was now looking at things with a “Lean head”, sometimes even applying Lean in their own homes (DE040). As discussed in Section 5.4, several strategies have been used to foster a positive attitude among the workforce.

By contrast, anecdotal evidence suggests that where the workforce is – or managers are – antagonistic to Lean then it is unlikely to succeed. A Lean consultant interviewed for this project reported often encountering resistance: “Very few people believe that Lean tools will work” (DE014). Similarly, a Lean practitioner from the Food Chain Centre encountered many negative attitudes. Reasons he was given for companies not implementing Lean included: “‘I’ve never heard of it’ … ‘It will take too much time’ … ‘I don’t have the skills’ … ‘It applies to the automotive industry but not to food’, and so on” (DE002). Similarly, actors in different supply chains within the UK dairy industry believed that Lean was not transposable to the dairy industry, although is for other industries (34).

One Lean consultant felt that the negative perceptions attached to Lean have been aggravated in the past when companies have brought in expensive Lean consultants only to find that, when the consultants depart they fail to leave behind the necessary skills and ability (DE002).

Another consultant interviewed for this project felt that Lean thinking was still in its infancy within food manufacturing: “It’s still a long way behind other industries, particularly automotive.” He commented that even the simplest tools are “hard to do well” and that although many companies claimed to be doing things, that this was just “window dressing”. He offered the example of the Lean technique 5S which, he says, “goes far beyond putting up shadow boards, it takes years to get to the right level of maturity; it’s essentially about discipline” (DE010). This seems to be borne out by a food manufacturer who reported that they had had a “5S system in place but it got a bit lost” and needed to be re-launched (DE041). The same consultant also saw ‘silo thinking’ as a major problem in the food sector: “People in different areas of industry - be they chilled produce, powders, sauces, baking – seem to think in different paradigms: for example, baking is a seen as a ‘black art’, while sauce-making is done ‘digitally’” (DE010).

Much the same opinions were offered by a different consultant who claimed that Lean was working properly in “only 5% of companies” he had visited. Interestingly it was the smaller companies where Lean worked best, normally as there was “a central character living and breathing the business.” For an SME, each decision taken has the potential to make or break the company (DE014). This view was echoed by a University academic with many years prior experience as a production manager in the food industry. He believed that SMEs could be good at Lean as it was “all about passion” and in “small companies the top guy tends to be very passionate and sees the changes through. It is unlikely that things will drift in a smaller company. Larger companies need to try to instil the passion but sometimes struggle” (DE032). A leading multiple retailer concurred that smaller manufacturers (c. 20 persons) were in fact “the keenest and hungriest” and had greater responsiveness and flexibility to change. Once the owner was committed to Lean, the process of engagement was straightforward (DP001).

An optimistic note was also struck by another University academic who had found that in his experience “around 10 to 25% of [UK food manufacturing] companies are genuinely open to the adoption of tools. The focus should be on them, and then other companies will be encouraged to take up Lean.” He disagreed with the view that there was no point implementing tools until the ‘behaviour was right'
A Lean 6Sigma ‘black belt’ project manager for a pharmaceuticals company - but with 20 years’ experience in the food industry - also disputed the contention that the food sector was poor at Lean. She pointed out that food manufacturers were driven hard by retailers “to reduce their costs”, so companies always had to “be on the top of their game, to be ‘smart’. Nevertheless she conceded that the attitude to waste in the food industry needed changing. “In my experience, food companies are happy to accept 5% waste, they will always do the quick and easy things first but they could be getting their waste down to 1% with much tighter process control - and with some investment. Whether or not a food company will invest will depend on the market they are in”

Similar views were echoed by a Lean practitioner from MAS who reported that food companies would use the excuse that they could not do as well as other sectors (e.g. automotive) because their raw materials (i.e. food ingredients) were “natural and too variable”. The interviewee felt that this was not a valid argument, especially for big companies that had a good idea of what sales were likely to be so could “smooth out things”. The same person also found that the managing directors of food companies sometimes didn’t see themselves as manufacturers at all but more as “artisans”, while those working on production lines tended to come from a “food safety or food quality background” rather than “a process engineering background”

5.2 Motivators

Asked what motivated his company to adopt Lean practices, a representative from a major UK food manufacturer replied that aim was “to create competitive advantage, to reduce losses of materials, labelling, packaging, and to increase our [profit] margin” (DE004). Indeed, the most commonly reported driver for the adoption of Lean thinking by food and drink manufacturers is the perception that, above all, it helps a company improve and maintain its competitiveness (6) (DE005) (DE031). This was supported by a former member of the delivery body Envirowise who claimed that, while a “nod to the environment” was important, the opportunity to save cost was the primary motivator for manufacturers undertaking Lean activities (DE001).

In the same vein, an expert involved in the Food Chain Centre pointed out that food companies started exploring Lean thinking in response to “a well-documented squeeze on household incomes, greater competition and the imperative to remove costs from the supply chain” (DE002). The Group Manufacturing Excellence Manager from one of the UK’s biggest food manufacturers remarked that although “environment, sustainability and the ethical agenda” were drivers, the rising price of fuel meant improving resource efficiency was now “the number one focus” for all food companies (DE019). “Reducing fuel bills rather than lowering CO₂ emissions” was also a driver cited for logistics improvements made by a leading drinks manufacturer (DE033).

A Lean expert from MAS reported that companies were motivated to support if (DE038):

- they are in trouble
- they have just received a huge order and need advice on how to deliver
- they want to put in a new process
- they have a quality problem
- they have a yield loss (i.e. general waste) problem.

Pressure from further down the food supply-chain also appears important, particularly from the powerful multiple retailers (DE003). According to an expert involved in the Food Chain Centre, the pioneering work undertaken by Tesco in the 1990s to implement Lean thinking has encouraged (or perhaps compelled) much of the rest of the food industry to follow suit. Tesco reportedly worked with universities and others to codify Lean thinking, and the approaches were then cascaded up Tesco’s supply chains (DE002). As noted below, the large retailers may also play a key enabling role.
Linked to the role of retailers are time pressures, especially for the chilled and fresh produce streams (DE003) which are growing in popularity among consumers. Fresh produce in particular can offer the greatest profit margins to retailers and their suppliers, so businesses are driven to make and sell as much of these foods as possible. But such products have a very short shelf-life, so manufacturers are at the same time incentivised to reduce inventory to the bare minimum; Lean practices may be viewed by manufacturers as one way of achieving this balance. (Although, as discussed in Section 5.3, for certain season-dependent products minimising inventory may not always be an option).

Trade bodies are increasingly acting not just as industry representatives but also as a driving force behind environmental – if not Lean – initiatives adopted by members. For example, the British Beer and Pub Association shares good practice in waste reduction, energy reduction, and packaging reduction.a

Often the trade bodies have launched (or are at least fully supportive of) voluntary agreements (VAs) and sector-level level targets which, as with other parts of the food supply chain, may act as important motivating and enabling factors. Examples identified in this review include the Food and Drink Federation’s Five-fold Environmental Ambition (7), the Federation House Commitment (8), the Dairy Roadmap (12) (24) and the Courtauld Commitment. The last of these, particularly, seems to be exerting significant influence on manufacturers. The Environment Health and Safety Group Manager of a major drinks brand talked about his company having “its arm twisted by the Courtauld Commitment to provide reports on its progress” (DE006).

CSR pressures must play some role in motivating Lean action, especially for the larger manufacturers. Indeed, much of the (limited) evidence collected for Lean activity is reported upon in company CSR reports. Kraft, Coca-Cola, Britvic, Diageo, Campbell Soups and Kellogg’s are among high profile examples. However, the importance of ‘good PR’ should not be overstated as many smaller manufacturers prefer to avoid any form of publicity; the food sector remains a notoriously secretive one, perhaps due to fears about revealing information to competitors. And a representative of a major drinks manufacturer reports that he feels pressures only “indirectly” to make environment savings. “If we’re going to do something,” he says, “it would be for a strong commercial reason” (DE006).

Environmental management systems (e.g. ISO 14001) play an uncertain role in that they can act both as a driver and a barrier to Lean thinking. In theory, EMSs are highly compatible with the Lean approach in their emphasis on Continuous Improvement: however, some cases are reported of companies which have achieved accreditation to an EMS and then decide that Lean thinking is not required as the “CI box has been ticked”. Interestingly, the representative from the large drinks company referenced elsewhere in the report which uses the TPM system points out that the system lacks an ‘environmental pillar’ because environmental impacts are already being addressed by a management structure set up for maintaining ISO 14001 and the need for regulatory compliance (DE013). One leading UK supplier of liquid egg products reported that its environmental vehicle, the ‘Green Scheme’ (which has Lean elements such as measuring and target-setting) was set up three years ago in response to the company’s decision to apply for ISO 14001. The interviewee reported that going for EMS accreditation, achieved for all its sites within 12 months, was a “big step” (DE042).

The ability of Government to drive change should not be ignored: one expert, who had been involved in the Food Chain Centre programme, reported that in the past Lean had not been pushed as much in the food industry as it had in others. He suggested that this might have been due to a quirk of Whitehall organisation. He suggested that in the 1990s, the Department for Trade and Industry ran a programme to disseminate Lean thinking to the specific sectors for which it had responsibility (e.g. oil, gas, electronics); the food sector was not among them, which may explain why Lean thinking has had less penetration in the food chain. Nevertheless, as stated in Section 0, the same interviewee estimated that “a third to a half” of the larger manufacturers have a knowledge of Lean (DE002).

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a Id 298
The recent WRAP and IGD-supported series of collaborations between major UK retailers and food manufacturers in which Lean tools feature prominently, is a sign that Government increasingly sees the value of such approaches. The longevity of the innovations piloted in these studies is unclear, although all conclude with a ‘roll-out and sustain’ phase in which the respective project teams applied ‘the improvements to other parts of their businesses, for example other products within the category or other categories.’ (ID412)

Finally, it is important to recognise that for individuals working at different levels within a company, their personal motivations may differ. As one interviewee points out, although the over-riding motivator is the opportunity to make savings, “for those working in a production environment, the opportunity to increase production may also be a motivator” (DE005). In fact, engaging staff at different levels is seen by some as a motivating factor in its own right. A representative from a drinks manufacturer found that theLean practices used in his company relied for their success on engaging “the guys on the shop floor” and because these staff were involved in the decision-making “they felt like they had a stake in the company.” This resulted in less absenteeism (DE008).

5.3 **Barriers**

A stakeholder from the former delivery body Envirowise suggested that the language of Lean manufacturing could be a barrier, and reported that his organisation tried to avoided using terminology in case it seemed too technical or complex and might alienate people (DE001). Similarly, a Lean food manufacturing specialist currently working on an EU-funded project with SMEs in the northwest of England reported that he found that smaller companies tend not to use specific tools as they were viewed as “too scientific” (DE016).

As discussed in Section 4.5, some tools, such as 6Sigma, may be regarded as “too bureaucratic”, especially for smaller companies (DE005). A Lean consultant interviewed for this project believed that some of the Lean terminology was viewed as ‘elite-ist’ and could exclude people from wanting to use the tools. He was against “over-professionalisation” (DE027), while a Lean consultant from the US pointed out that Lean had been given a bad name in the past as the tools were sometimes used as way of identifying and making staff redundancies (DE031). Interestingly, a leading multiple retailer changed the name of its operational improvement initiative from ‘the Lean Team’ to ‘the Simple Team’ for similar reasons. The head of the Simple Team, interviewed for this project, reported that for shop workers the term ‘Lean’ suggested that they might have their working hours cut. The rebranding as ‘Simple’ communicated that the initiative was “about reducing the non-value added tasks and making things easier” (DE034). A different retailer interviewed for this project reported that its suppliers often saw Lean as “complicated” and the language “impenetrable”, and they were reluctant to hire “costly consultants”; furthermore, the results would be “possibly un-sustained” (DP001).

A fundamental constraint identified by stakeholders (DE003) (DE036) to Lean thinking in the food chain which applies as much to manufacturers as it does to retailers is the “fear of the empty supermarket shelf”. The imperative for ‘resilience’ in the supply chain encourages all sections of the supply chain to over-produce and hoard stock “just to be on the safe side”. Similarly, for some ingredients with short harvesting windows there is no alternative but to store products in bulk. For instance, a years’ supply of fresh vegetables such as garden peas has to be picked at once, frozen and then sold over the course of the rest of the year. This kind of inventory-holding is contrary to Lean, but is necessary. Some smaller manufacturers, or those producing ambient foods (e.g. canned and dry goods), may view long production runs and batch processing as the best way to optimise their costs. All such activities oppose Lean principles; however, as one trade association representative commented, “if all diesel was abolished on a Monday, the shelves in the supermarkets would almost be empty by Thursday – so you can’t get Leaner than that!” (DE003).
Another significant barrier to improving resource efficiency through Lean and Continuous Improvement approaches could be described as the ‘moving goal-posts problem’ (DE032). One major manufacturer in the chilled food sector reported that customer demand for an ever-changing variety of products - in the jargon, the need constantly ‘to excite the consumer’ - means that “every six to nine months products have to change to a greater or lesser extent, from a new recipe to a complete redesign of product packaging, leading to a level of reactivity in the business”. The interviewee believed manufacturers may simply not have the “luxury of being able to apply Continuous Improvement when products are changing so fast” (DE004). However, as mentioned in Section 5.4, getting the communication right and using tools such as the ‘visual factory’ may help manufacturers cope in a fluid environment (DE032).

Another potential constraint, according to a University academic, could be a “lack of understanding of the value of Lean”; while no evidence was offered to support this assertion (DE012), other work does suggest that a lack of senior management buy-in can act as a barrier to the implementation of Lean approaches. One consultant reports: “[Senior executives] can sometimes be impatient to see results, a return on their investment in us, and if they don’t come quickly enough they may decide not to bother with Lean. Lean relies on cultural change which takes time. It’s always a trade-off” (DE035). The recent WRAP & IGD-supported collaborations between retailers and suppliers using Lean-type approaches sought to address this issue by demonstrating that the programme was ‘of commercial benefit to participating companies ... [which] was critical to both the design and execution of projects.’ (ID412)

A manager responsible for packaging at a leading multiple retailer interviewed for this project pointed out that, although improving resource efficiency was important for the food sector - for instance through reducing packaging weight and extending product shelf-life (which also provided financial savings) - his over-riding priority was food safety which “trumps everything else”. He could not, however, provide further detail on how protecting food safety might conflict with Lean goals (DE020).

A consultant reported a lack of focus as additional barrier: “When implementing Lean – companies try to address lots of little things without prioritising the thing which will make the single biggest difference. In the food and drink sector, the main issue is the short shelf-life which affects the dynamics around ordering.” He cited other possible constraints such as “lack of skills and time to understand yield losses – it tends to be a very intense business with lots of ‘fire fighting’” (DE025). A representative from a leading multiple retailer interviewed for this project saw something in the character of people working in manufacturing: the industry had a propensity to employ managers who were “addicted to chaos” and thrived on the “adrenalin of moving from crisis to crisis”. They were therefore not receptive to a mode of operating within control bands and longer term targets or even co-operating across company boundaries (DP001).

The shortage of human resources to keep up Lean advances was also mentioned by a University academic. He pointed out that in the UK around “65% of fresh foods are sold under retailers own brand label” and tend to take the form of chilled produce with a short shelf-life. The net result is that manufacturers in these sectors whose margins are being squeezed all the time “don’t have the human resources to keep up the Lean system. A lot of the effort in setting up a system is thus lost.” The interviewee recommends that manufacturers put in effort to train the “right people” so that the business adopts a new way of working (DE032).

The American Lean consultant referred to above also noted that in the UK he has found that company structures are often ‘too hierarchical’ which can prevent Lean using input from everyone (DE031). Linked to this was the earlier observation that environmental managers can be detached from mainstream operations and may have little influence in the organisation (4).

Some barriers are more physical than behavioural. As a Lean consultant from the US points out, “in food manufacture facilities there are a lot of ‘monuments’ i.e. fixed plant, so it is difficult to apply certain Lean
tools for improving factory layouts” (DE031). According to a forthcoming report for WRAP on production-ready packaging, site constraints were cited as barriers by the environmental manager at Ginsters; the Cornish-based pasty and pie-maker already uses bulk delivery for certain key ingredients such as flour and potatoes which are stored in silos prior to use, but is unable to source any spices including salt and pepper in formats larger than 25kg as no room is available for a silo close to the plant’s ‘spice room’. In the future, Ginsters may relocate the spice room in order to allow a salt silo to be installed – however this will require significant capital expenditure and thus would be out of the scope of Lean as defined in this project.

5.4 Enablers

A representative of a UK drinks manufacturer, whose company was recently bought by a multinational drinks group, reported that the highly formal system known as TPM (described in Section 4.5) which was already operating in the parent company was simply imposed on the new acquisition (DE008). Indeed, the evidence gathered for this project supports the notion that Lean thinking is generally a ‘top-down’ initiative (DE003). Perhaps this is so because it is driven by ‘commercial pressures’ (DE004), most acutely felt in the boardroom. Without senior management buy-in, any attempt to introduce Lean techniques and tools would be futile.

However, the available evidence - both literature-based and that gathered from stakeholder interviews - clearly indicates that the success of a Lean initiative also hinges on whether or not personnel at all levels in an organisation can then be engaged and their behaviour changed. One trade association representative reports that “[for Lean to succeed] it needs to develop into a complete environment throughout the whole company; production and process managers, packaging managers, directors and specialists all develop it further” (DE003). A similar message comes from an interim project manager with long experience of implementing Lean projects in the food sector: “It is absolutely crucial to get buy-in throughout the organisation from the top down to the person sweeping the floor. It can’t be piecemeal. The whole thing fragments if separate departments start doing their own thing. Communication is also vital. The biggest problem is the failure to communicate. Middle managers may have ideas but they don’t always filter down to the shop floor” (DE026). The importance of communication was echoed by a University academic with many years’ experience in the food industry. He argued that tools relating “to improving communication and the ‘visual factory’” help manufacturers deal with the constantly changing environment in which they are working – with product changes being demanded all the time (DE032).

Several other cases of employee engagement being key to, or an integral part of, Lean actions by manufacturers have been identified in the published literature and by interviewees. For instance, after developing a programme of employee engagement in waste reduction, the FDF reports that a member company, United Biscuits (UB), achieved an 18% reduction in food waste in the first eight months of 2008 compared with the same period in 2007 (19). UB also achieved reductions in water use (7).

A number of tactics are employed to change employee behaviour – not only to carry out tasks in a Leaner way – but also to get the workforce to embrace Lean thinking in the first place. Strategies include keeping staff regularly updated on progress towards goals through regular updates, newsletters, etc. (8) (19), encouraging competition between different manufacturing sites (8), welcoming new ideas and suggestions for improvement from any level in the company hierarchy (19), the use of posters and information boards (37), and appointing and empowering champions (19) (8). The owner of a very small food business formerly worked as a senior Lean engineer at an automotive firm. She recalled how 6Sigma had been introduced as “a top-down thing” but she found that “60-70% of the new ideas came up from the shop floor”. Examples included suggestions to reduce waiting times, walking distances etc.

a WRAP. Production Ready Packaging: A review of the opportunity for production ready packaging in the UK food and drink sector. Written by Oakdene Hollins Ltd. Forthcoming.
“Management would weigh up these suggestions and judge which changes would make the greatest savings” (DE005). An American Lean consultant interviewed for this project put it simply: “Lean is an opportunity to use everyone’s brain”, although as discussed in Section 5.3, the same person pointed out that the hierarchical structure of many UK companies might constrain this (DE031).

Another interviewee, a consultant, reinforced the importance of engaging staff in measuring resource use and problem solving. He reported that when attempting to minimise unnecessary energy or water use in a company, the measuring tasks should be “devolved down to the people actually spraying around the water and leaving the lights on rather than necessarily to an energy or water manager who has less direct control” (DE010). A food manufacturer and operator of a food service division reported that good resource efficiency results had been achieved by ensuring all teams were aware of the “costs of waste and the company’s sustainability agenda” (DE018).

Importantly, while engaging all levels of the company in a Lean transformation is vital, it seems less critical for everyone to be trained on the tools. A manager responsible for OE at a leading drinks manufacturer argued that people “shouldn’t get too hung up on the tools – you only need five to ten tools to make a real difference, and it’s not important that all employees in the plant know all the tools, they just need to be brought in for their knowledge of their own aspect of the process” (DE033).

If changes to company culture and operations cannot be accomplished internally, then external influences may be needed in the form of sector-wide, voluntary agreements. External consultants have also proved to be important enabling factors, whether supported through publicly funded programmes (e.g. Envirowise, MAS, WRAP, NISP, Food Chain Centre, RDAs, EU, etc.) or paid for by the company itself (e.g. Suiko, Newton Europe). An OE manager at a leading UK drinks brand recommends bringing in external experts when senior management are resistant to ideas for change coming from within their own company: when those suggestions for change come from outside consultants they are more likely to be viewed as “impartial” (DE033).

A representative from a major UK manufacturer reports that over the last 10 years his company has frequently brought in third-party ‘operational effectiveness consultants’ on a short-term basis who apply their expertise to specific business units within the company (DE004). Similarly, an international drinks manufacturer uses a consultancy firm to help embed TPM (DE013). One such consultant describes his company’s methods: “We use what we call an ‘Operational Excellence’ approach which may use a range of tools - kaizen, Lean, 6Sigma, Continuous Improvement and so on. But we don’t too hung up on specific tools ... The key thing is getting the behaviour right in a company, getting people to think in a different way, which tools are used is then the next step – they are really just enablers, they’re like the spanners”. The consultant adds that “it needs to be an 80% focus on behaviour, 20% on the tools. Some tools are just not needed for the food sector” (DE010).

As discussed in Section 4.5, the role of external consultants in changing behaviour was also highlighted by an interim project manager who described how consultants used game-playing to train employees in the use of 5S techniques which “was a really good way to overcome resistance to change” (DE011).

A different consultant claimed to have “put £3m straight onto the bottom line” after working with a large salad producer (with a £90m turnover). He reported that he had “changed the way people in the company think”. He also “took out some of the automation” and put in more manual cellular manufacturing and reduced the lead time by 12 hours” (DE014).

A good example of how an external point of view can make a difference was offered by a Lean consultant who described how he worked with a large company making mozzarella cheese for pizzas. A lot of problems were caused by the bags leaking so he advised the company to make the bags thinner rather than thicker which improved sealing. This led to a 75% reduction in downtime allowing for uninterrupted 18 hour production runs and 6 hour downtime for repairs and maintenance. The consultant said that “the
people at the plant were not stupid, they just needed an external view to notice and solve the problem” (DE027).

If the large multiple retailers have acted as powerful motivators for Lean thinking, they are also playing an increasing role in enabling Lean thinking; ‘retailer pressure’ can be viewed in a positive as well as negative light. The Retail & Distribution report records many examples of retailers engaging positively with their supply chain, providing training and other support in order to improve the resource efficiency of suppliers. For instance, a representative from a major food manufacturing firm singled out Marks & Spencer in particular, praising the company for the way it works with its entire supply chain as part of the Plan A eco-strategy (DE004). One retailer reported that, with advice from a Lean consultancy, it had recently implemented a Lean rating scheme for its suppliers; 18 months in, although none achieved ‘Gold level’, two were now rated as ‘Silver’. Suppliers needed a great deal of support in embarking on this journey, which was described as “staring over a precipice of commitment”. Training was a key element, and engagement of the Skills Councils had provided funding to kick-start education (DP001).

The interviews conducted for this project suggest a trend towards not only whole supply-chain engagement on implementing Lean thinking, but also towards the greater ‘visibility’ of information previously regarded as commercially sensitive to individual players - or perhaps not measured at all. As one large food manufacturer put it: “Food companies are no longer just focusing on their own silos but they’re engaging with their whole supply chain including sharing information such as on demand forecasting, stock inventory, waste – however prices may remain confidential” (DE004). This statement seems to be contradicted by the Lean consultant cited in Section 5.1, who still saw a lot of ‘silo-thinking’ in the sector, and again stressed the importance of supply chain visibility in the food sector: “You need to tackle waste in a big way, across entire supply chains through VSM. You need transparency as to what is going on. Bigger companies shouldn’t be robbing Peter to pay Paul. You need to eradicate the waste altogether. But it is very hard to get people to do this” (DE010).

According to one small manufacturer, for Lean thinking to be a success, staff need to be trained effectively: “People don’t want to read a manual, they respond better when they are shown Lean approaches in an easily understandable way” (DE005).

Given the importance of changing cultures and engaging staff at all levels in, the recent WRAP and IGD-supported retailer-supplier collaborations saw the following as key factors facilitating the success of the Lean approaches (ID412):

- Providing teams with confidence to innovate
- Agreement, documenting and distributing actions, responsibilities and deadlines
- Identifying and addressing individuals’ concerns
- Capitalising on individuals’ positive feelings
- Committing teams to reporting deadlines
- Co-ordination and cross fertilisation amongst teams
- Scrutiny and constructive criticism of progress of other teams
- Capturing business results and learnings
- Sharing success stories/tools with other categories.
6 Learning

6.1 Insights

The literature review and initial stakeholder engagement exercise have generated a number of observations and insights:

Observation 1: Lean-like principles, such as measuring and KPIs, have entered the environmental discourse.

Lean-like manufacturing tools are penetrating the policy and sector level discourses. Many of the voluntary and sector level agreements instigate the setting of targets for the companies that are signatory to this agreement and sometimes to KPIs that relate to the generation of environmental wastes. Sectors in which measuring is commonplace, such as brewing, have been observed to more easily make large leaps in environmental improvement. In an earlier study, Boston Consulting Group identified four stages of Lean implementation in food manufacturers. Current initiatives in the environmental stage can be seen as adding a stage preceding ‘real’ Lean implementation (Table 49).

Table 49: Stages of Lean Implementation for environmental improvement

<table>
<thead>
<tr>
<th>Stage</th>
<th>Companies in this category</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 0: Supported environmental impact reductions</td>
<td>Majority</td>
<td>The voluntary agreements, ‘ambitions’ and outreach of trade associations lead companies to employ certain Lean techniques such as metering, and to focus on targets.</td>
</tr>
<tr>
<td>Stage 1: Force for modest change</td>
<td>Minority</td>
<td>There is an established Lean function, but companies do not have a clear picture of their non-value adding manufacturing cost. While many have designated Continuous Improvement managers, these have to fight to put their ideas into practice. Productivity gains are mostly through capital expenditure.</td>
</tr>
<tr>
<td>Stage 2: One-off business driver</td>
<td>Few companies</td>
<td>Companies have long-established Lean practice. Databases on best practice, but results do not really stick. Energy behind Lean initiatives is gone. Companies risk falling back to stage 1.</td>
</tr>
<tr>
<td>Stage 3: Sustained improvement contributor</td>
<td>Few companies</td>
<td>Companies work consciously to transform their entire culture into one of continuous sustainable improvement.</td>
</tr>
<tr>
<td>Stage 4: Source of competitive advantage</td>
<td>Very few companies</td>
<td>Embrace stage 3 and go further to set up supply-chain Lean initiatives as a source of competitive advantage.</td>
</tr>
</tbody>
</table>

Source: Oakdene Hollins adapted from BCG (43)

Observation 2: Commitments to Continuous Improvement are often part of voluntary and sector-wide agreements.

Voluntary agreements are typically supported by high profile communications strategies. Progress towards the stated goals of the agreement is regularly reported which encourages Continuous Improvement among signatories. The responses to VAs and their like represent important strides forward (e.g. through the introduction of measurement, target-setting and the fostering of continuous improvement, etc.), but to date such initiatives have tended not to entail more sophisticated activity among manufacturers (e.g. 6Sigma, VSM, etc.). The extent to which VAs may drive the uptake of more
advanced Lean tools is debatable. However, that they at least prepare the ground is highly probable. Evidence of the use of more advanced Lean practices is often associated with some form of direct business support: for instance, Envirowise helping manufacturers introduce statistical process control to solve overfill problems. (41) Unfortunately, the best example of the use of advanced tools reported in the literature - namely the work of the Food Chain Centre - lacks detail on savings, whether actual or likely to be achieved.

**Observation 3: Water metering has increased over the past years.**

A relatively large number of examples of companies updating their water metering practices were reported in the literature. This was less so for measuring raw material waste, packaging waste, energy and greenhouse gas emissions. Whether this is because these actions have not been reported or whether these are more difficult to measure is not clear at this point.

**Observation 4: Regulation can have unintended consequences and cause companies to set resource inefficient targets.**

The practice of C. Shippam Ltd, the canned food manufacturer described in Section 4.5, highlights the problem of consumer-oriented targets sometimes acting as a barrier to improving resource efficiency in the food industry. Compliance with Regulation is often the target for individual companies, and waste reduction targets are generally less important.

**Observation 5: Examples of advanced Lean tools in food and drink manufacturing are sparse.**

The reported examples of advanced Lean or Lean-like tools in literature in the public domain are sparse. One reason could be that manufacturers could be wary of giving away trade secrets and keep the actions with which they have been able to make environmental and cost gains within the organisation.

**Observation 6: The data does not give an idea on what the ‘most effective’ Lean tools are.**

Savings data are reported in some cases, but it is often difficult to estimate which proportion of the savings is due to the Lean actions and which due to opportunistic improvements. In addition, determining a ‘20% savings in water use’ through a particular tool does not indicate that this tool can provide similar savings in a different context.

### 6.2 Opportunities

A stakeholder interviewed for this project who had been involved in the Food Chain Centre argues strongly for the application of Lean thinking to the food industry (DE002). A clear opportunity certainly exists: however, the available evidence unfortunately fails to provide an obvious steer as to which would be the most effective Lean tools. Food and packaging waste should be an obvious focus. As described by one Lean consultant, “it’s gob-smacking how much wastage there is. There’s a lot of noise in the system” (DE010). Similarly, another consultant put the savings to be won in the food chain at “over £1 billion.” He argued that for larger companies the opportunities to make savings are vast – “you could wipe out their pension deficits in one go.” The same consultant suggested that Lean offered great opportunities for smaller manufacturers too, and it was the smaller companies where Lean often worked best (Section 5.1) (DE014).

The message was reinforced by a University academic – and former Lean manager in the automotive sector – who was a “firm believer in Lean.” He reported that a key element of Lean was looking at reducing variability and increasing product quality: “If you allow a bad product to be made in the first place this result in significant waste of water, energy and materials, and expense in management time further down the supply chain … Lean is good at stopping making bad products. It stops people waving
their arms around rather than getting on with their jobs ... Lean can give an enormous environmental savings” (DE036).

One Lean consultant recommended learning lessons from the big manufacturers in the automotive sector: “For instance, their use of open book accounting, and working with and supporting suppliers to drive down waste and hence all sharing in the savings” (DE010). The automotive sector can also provide more direct support. This was evidenced in the northeast of England where training was provided to a ready meals factory by a Lean expert from the local Nissan factory (see Section 4.5) (DE026). One well-known retailer interviewed for this project reported that it was planning to introduce automotive-style supply-chain management whereby suppliers (including manufacturers) would be helped to feed back capacity and planning data, preventing phenomena such as demand amplification (DP001).

Stressing the importance of company leaders seeing the benefits of Lean for themselves, an American Lean consultant recommended that senior managers visit peers’ plants where Lean was working well (DE031). This seems unlikely given the intense competition in the UK food and drink sector: however, a different Lean practitioner interviewed for this project reported taking SMEs on ‘best practice’ visits to see how leading companies such as Coca Cola and Britvic did Lean. The interviewee said that the aim the visits was to demonstrate that “Lean is basically just common sense” (DE039).

According to the literature reviewed, a few other opportunities can be identified:

- Typically, organisations include resource efficiency under the general classification of environmental management. However, the environmental management is often detached from mainstream operations and is often delegated to a single person or function with little influence in the organisation. For significant raw material savings to be realised, it is important that production managers are fully engaged (4). The surge in resource efficient activity in companies participating in environmental agreements may indicate that such agreements are starting to give environmental managers the necessary leverage within organisations. This might present opportunities.
- Many of the moves toward continuous environmental improvement are initiated by targets set by sectors or by sector-specific agreements. Sector-level voluntary targets on water reduction seem to have increased practices like metering. If the focus in the support for these agreements is shifted from metering to more advanced Lean or Lean-like tools, advances in other practices could be observed.
- A focus on compliance with regulation can lead to wasteful activity in different ways and endorsement by regulation can falsely provide the impression that meeting these targets is ‘good practice’. Opportunities are likely to exist in areas where environmental or business legislation is currently allowing wasteful activity.
- Actors in different supply chains in the dairy industry were of the opinion that Lean is not transposable to the dairy industry, although it is for other industries (2). Actors involved in Food Chain Centre case studies in the red meat industry stated to have little prior knowledge about Lean (35). This indicates that there still is significant opportunity in the UK to raise awareness of Lean, possibly by combining cost-saving and environmental arguments in communication strategies.
- In an analysis of manufacturing techniques of 13 FDF members, significant opportunities for resource efficiency were identified, such as SKU analysis, development of environmental KPIs and associated data, development of contingency planning for rework and quantifying and challenging absolute raw material wastage (4).
- A study on waste minimisation strategies in the food industry in the UK published points out that SMEs generally state they have insufficient resources available for waste minimisation (44).

6.3 Gaps

The foregoing review has presented a great deal of qualitative evidence on Lean activities undertaken in the food and drinks manufacturing sector, as well as information on attitudes, barriers, motivators and
enablers. However, rather fewer quantitative data were available on savings from specific actions which makes it difficult to comparing one type of Lean activity with another.

There are significant gaps in the published evidence base for the effective use of Lean tools in the food and drink manufacturing sectors:

- As product ranges are large within each manufacturing sub-sector, the evidence only covers part of the manufacturing sectors. Literature across product ranges could contribute to more targeted recommendations on relevant Lean tools and actions.
- Sector-level support actions have been identified as important catalysts for reporting Lean or Lean-like activity. As the literature study has focused largely on recent literature (2007-2011) many previous implementations of Lean-like tools with environmental benefits have been missed.
- The paucity of good quality, detailed case studies in the published literature may explain the lack of evidence for advanced tools.
- The processes by which adaptations and savings have been achieved by manufacturers are generally not extensively reported, perhaps as in-plant activity is regarded as a commercially sensitive. The literature research has therefore been complemented with primary research in the form of interviews. Savings data remain under-reported in these exercises. Future research should focus on talking to manufacturers which have fully implemented Lean.
- Reported actions were in most cases not linked to specific ‘root causes ‘of wasteful activity. To find out more about the practices - or the absence of practices - that lead to different types of wasteful activity, more primary research is needed.

A potentially interesting research gap was identified during an interview with a University academic (and former Lean manager from the automotive sector). He pointed out that ‘one piece flow’, a key aspect of Lean which aims to synchronize a manufacturing system to the customer’s needs, is sometimes criticized as contradicting environmental imperatives because it results in “lots of changeovers” (so energy and other resources are wasted while machines are running during downtime) and “perceived distribution and transport impacts.” The academic stresses that, if done properly, Lean is initially very good at eliminating “stupid wastes” and so does improve resource efficiency: however once Lean “matures” in a company “the rate of environmental improvement may actually slow down” because Lean is ultimately focused on “improving productivity rather than resource efficiency”. A theoretical example offered is the case of a machine left running over lunchtime. Lean Thinking may dictate that the machine be left running because this would avoid variability in product quality caused by switching it off and starting it up again in the afternoon. By contrast, resource efficiency imperatives might require the machine to be turned off to reduce energy use. Thus, a fruitful area of future research may investigate instances where “Lean” does not necessarily equal “green” – or perhaps examining whether and where ‘trade-offs’ may occur (DE036).
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35. —. Applying lean thinking to the red meat industry. Letchmore Heath : Food Chain Centre, 2011. id 103.


44. Park, Chris. Green Lean Six Sigma: Using Lean to help drive results in the wholly sustainable enterprise. London : Deloitte. id 038.


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Appendix 6: Retail and Distribution
FO0425 – Lean Thinking in the Food Chain
Phase 1 Report: Review of activities – retail and distribution

A report for
Defra

August 2012
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## Glossary

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS</td>
<td>Lean technique</td>
</tr>
<tr>
<td>BRE</td>
<td>BRE, formerly Building Research Establishment</td>
</tr>
<tr>
<td>CC2</td>
<td>Courtauld Commitment Phase 2</td>
</tr>
<tr>
<td>CO2e</td>
<td>The GHG emissions stated as equivalent tonnes of carbon dioxide</td>
</tr>
<tr>
<td>CRC</td>
<td>UK’s Carbon Reduction Commitment</td>
</tr>
<tr>
<td>CSR</td>
<td>Corporate Social Responsibility</td>
</tr>
<tr>
<td>DECC</td>
<td>Department for Energy &amp; Climate Change</td>
</tr>
<tr>
<td>DMAIC</td>
<td>‘Define, Measure, Analyse, Improve and Control’ improvement philosophy</td>
</tr>
<tr>
<td>FCC</td>
<td>Food Chain Centre</td>
</tr>
<tr>
<td>FHC</td>
<td>Federation House Commitment</td>
</tr>
<tr>
<td>FMG</td>
<td>Fast moving goods</td>
</tr>
<tr>
<td>FVCA</td>
<td>Food value chain analysis</td>
</tr>
<tr>
<td>IGD</td>
<td>The Institute of Grocery Distribution</td>
</tr>
<tr>
<td>KPI</td>
<td>Key process indicator (of performance)</td>
</tr>
<tr>
<td>MSC</td>
<td>Marine Stewardship Council</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-governmental organisation</td>
</tr>
<tr>
<td>NFU</td>
<td>National Farmers’ Union</td>
</tr>
<tr>
<td>NPI</td>
<td>New product introduction</td>
</tr>
<tr>
<td>POS</td>
<td>Point of sale</td>
</tr>
<tr>
<td>RDC</td>
<td>Regional distribution centre (also DC)</td>
</tr>
<tr>
<td>RFID</td>
<td>Radio frequency identification device</td>
</tr>
<tr>
<td>RSPCA</td>
<td>Royal Society for the Prevention of Cruelty to Animals</td>
</tr>
<tr>
<td>RTP</td>
<td>Returnable transit packaging</td>
</tr>
<tr>
<td>SDDG</td>
<td>Sainsbury’s Dairy Development Group</td>
</tr>
<tr>
<td>SIC</td>
<td>Standard Industrial Classification (code)</td>
</tr>
<tr>
<td>SME</td>
<td>Small-Medium Enterprise (EU definition)</td>
</tr>
<tr>
<td>SMED</td>
<td>Single minute exchange of dies – Lean technique</td>
</tr>
<tr>
<td>SMG</td>
<td>Slow moving goods</td>
</tr>
<tr>
<td>SVN</td>
<td>Sustainable value network</td>
</tr>
<tr>
<td>tpa</td>
<td>Tonnes per annum</td>
</tr>
<tr>
<td>VA</td>
<td>Voluntary agreement</td>
</tr>
<tr>
<td>VSM</td>
<td>Value stream mapping</td>
</tr>
<tr>
<td>WRAP</td>
<td>Waste &amp; Resources Action Programme</td>
</tr>
<tr>
<td>WWF</td>
<td>Worldwide Fund for Nature</td>
</tr>
</tbody>
</table>

### Units

Conventional SI units and prefixes used throughout: (k, kilo, 1,000) (M, mega, 1,000,000) (G, giga, 10⁹) (kg, kilogramme, unit mass) (t, metric tonne, 1,000 kg)
Context of this Report

This report is one module of the Phase 1 report of the FO0425 project, FO0425-Phase1-Report. It deals specifically with activities occurring within the retail and distribution operations of the sector. Conclusions of the report have been abstracted into the Phase 1 Report but readers should consult this module for full details of the evidence review.

Conventions & Language used in this report

Bibliographic sources are cited in numerical order thus (2 p xx). Private communications are referenced uniquely by consultant initial and id number thus (DE009).

In addition, this report uses the terms ‘Clean Operations’ and ‘Waste Minimisation’. These concepts were developed by Oakdene Hollins for a previous Defra project on Business Waste Prevention (WR1403) as part of a framework for evaluating the actions a business takes to improve resource efficiency (Approaches), and mechanisms that have catalysed the actions (the Interventions). A brief reference outline to the Approaches is given here:

**Positioning of approaches in response to business drivers including waste**

<table>
<thead>
<tr>
<th>Process</th>
<th>FOCUS</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incremental</td>
<td>CHANGE</td>
<td>Radical</td>
</tr>
<tr>
<td><strong>Clean Operations:</strong></td>
<td>More radical restructuring of processes “new, green, clean”, often cooperating with others in the supply chain.</td>
<td><strong>Product–Service Innovation:</strong></td>
</tr>
<tr>
<td><strong>Waste Minimisation:</strong></td>
<td>Traditional in–process housekeeping, including Lean, to improve conversion of input to outputs within current production system.</td>
<td><strong>Green Products:</strong></td>
</tr>
</tbody>
</table>

*Source: Oakdene Hollins*
Retail, Wholesale and Distribution in Context

This report considers the evidence for Lean thinking in businesses falling into a range of SIC codes encompassing the retail, wholesale and distribution sub-sectors (Table 50).

<table>
<thead>
<tr>
<th>SIC Code</th>
<th>Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>46</td>
<td>Wholesale trade, except of motor vehicles</td>
<td>Wholesale trade, except of motor vehicles and motorcycles</td>
</tr>
<tr>
<td></td>
<td>and motorcycles</td>
<td>46.3 Wholesale of food, beverages and tobacco</td>
</tr>
<tr>
<td></td>
<td></td>
<td>46.310 Wholesale of fruit and vegetables</td>
</tr>
<tr>
<td></td>
<td></td>
<td>46.320 Wholesale of meat and meat products</td>
</tr>
<tr>
<td></td>
<td></td>
<td>46.330 Wholesale of dairy products, eggs and edible oils and fats</td>
</tr>
<tr>
<td></td>
<td></td>
<td>46.341 Wholesale of fruit and vegetable juices, mineral water and soft drinks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>46.342 Wholesale of wine, beer, spirits and other alcoholic beverages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>46.350 Wholesale of tobacco products</td>
</tr>
<tr>
<td></td>
<td></td>
<td>46.360 Wholesale of sugar and chocolate and sugar confectionery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>46.370 Wholesale of coffee, tea, cocoa and spices</td>
</tr>
<tr>
<td></td>
<td></td>
<td>46.380 Wholesale of other food, including fish, crustaceans and molluscs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>46.390 Non-specialised wholesale of food, beverages and tobacco</td>
</tr>
<tr>
<td>47</td>
<td>Retail trade, except of motor vehicles</td>
<td>Retail trade, except of motor vehicles and motorcycles</td>
</tr>
<tr>
<td></td>
<td>and motorcycles</td>
<td>47.1 Retail sale in non-specialised stores</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.110 Retail sale in non-specialised stores with food, beverages or tobacco predominating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.2 Retail sale of food, beverages and tobacco in specialised stores</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.210 Retail sale of fruit and vegetables in specialised stores</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.220 Retail sale of meat and meat products in specialised stores</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.230 Retail sale of fish, crustaceans and molluscs in specialised stores</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.240 Retail sale of bread, cakes, flour confectionery and sugar confectionery in specialised stores</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.250 Retail sale of beverages in specialised stores</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.260 Retail sale of tobacco products in specialised stores</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.290 Other retail sale of food in specialised stores</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.8 Retail sale via stalls and markets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.810 Retail sale via stalls and markets of food, beverages and tobacco products</td>
</tr>
<tr>
<td>49</td>
<td>Land transport and transport via pipelines</td>
<td>Land transport and transport via pipelines</td>
</tr>
<tr>
<td></td>
<td></td>
<td>49.2 Freight rail transport</td>
</tr>
<tr>
<td></td>
<td></td>
<td>49.200 Freight rail transport</td>
</tr>
<tr>
<td></td>
<td></td>
<td>49.4 Freight transport by road and removal services</td>
</tr>
<tr>
<td></td>
<td></td>
<td>49.410 Freight transport by road</td>
</tr>
<tr>
<td>50</td>
<td>Water transport</td>
<td>Water transport</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50.2 Sea and coastal freight water transport</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50.200 Sea and coastal freight water transport</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50.4 Inland freight water transport</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50.400 Inland freight water transport</td>
</tr>
<tr>
<td>51</td>
<td>Air transport</td>
<td>Air transport</td>
</tr>
<tr>
<td></td>
<td></td>
<td>51.2 Freight air transport and space transport</td>
</tr>
<tr>
<td></td>
<td></td>
<td>51.210 Freight air transport</td>
</tr>
</tbody>
</table>

Source: [http://www.siccodesupport.co.uk/](http://www.siccodesupport.co.uk/)
1.1 Retail

The UK retail sector, which comprises 100,000 outlets and employs over 1.157 million people\textsuperscript{158}, is represented by more than 55,000 enterprises. However, decades of consolidation have left a handful of businesses now dominating the UK grocery market (worth £146.3bn in 2009). Today, large multiple retailers, sometimes known as the ‘Big Five’ (Tesco, Sainsbury’s, Asda, Morrisons, Co-operative), each with turnovers exceeding £1 billion, account for perhaps 84% of grocery sales (1 p. 22). While traditional smaller independent stores are in long-term decline, the convenience sector (including garage forecourts, railways stations, motorway service stations and home delivery) has enjoyed a resurgence in recent years thanks to growing household incomes and increased value placed on leisure time. Major multiples as well as ‘symbol groups’ such as Spar and Londis have capitalised on the convenience trend (2).

Although less resource-intensive and with less waste arising compared to food processing (3 p. 88) (2 p. ii), the retailers face some important challenges. Most salient among these is probably high customer expectations; when consumers enter a supermarket they expect not only to find staple provisions (‘the basics’) but also an ever-improving range of new products at the lowest possible price.

Despite purported public concern over food miles, customers demand the same wide range of products at any time of the year; any short-fall has to be made up from imported goods – leading to greater environmental impacts from long distance transport and also increasing the likelihood of incorrect demand forecasting. In practice, errors in forecasting frequently result in a phenomenon known as ‘demand amplification’\textsuperscript{159} (4 p. 24), whereby slight changes – often a temporary rise – in end-user demand are progressively amplified back up the supply chain resulting in over-production (Figure 91). The underlying problem is that feedback control systems (which provide up to date information of actual demand for a specific product) are absent, so managers tend to over-order ‘just to be on the safe side’ (5 p. 9) (6 pp. 488-9) – and manufacturers over-produce for the same reasons.

Figure 91: Demand amplification

\begin{figure}
\centering
\includegraphics[width=\textwidth]{demand_amplification_graph.png}
\caption{Demand amplification graph showing order and production data for a specific steak product.}
\end{figure}

Source: Lean & Green Value Chain Analysis. Ready Meals From Butchery to Shelf. SA Partners (2010)

NB: Variations of 32% in orders for a specific steak ready meal from the retailer (Marks & Spencer) results in variations of 55% in steaks being produced by the manufacturer (YPM).


\textsuperscript{159} Alternative names for the phenomenon include the ‘bullwhip effect’ (29) or ‘Forrester effect’ (6)
An academic interviewed for this project, reports a growing demand by consumers for ‘fresh’ products, typically chilled and with a short shelf-life. He suggests that UK retailers have actively stimulated this desire since the profit margins that can be achieved are significantly higher for a fresh product which has a more attractive caché than the frozen or ambient equivalent (e.g. a chilled ready meal may be as much as four times more expensive than its frozen counterpart, although the two products may be virtually identical in their ingredients) (DE032).

Unfortunately, the very products which are so in demand are also the ones – due to their perishable nature - most likely to be wasted due to failures in demand forecasting, especially when sourced from overseas suppliers. According to a 2007 report, food ‘wastage in the distribution chain is typically between 10% and 20% compared with wastage from prepared and packaged foods “stabilised” foods, which is less than 1%’. (2 p. 30) In the academic’s opinion, the rising demand for fresh produce is as much of a challenge for the UK food chain as, for instance, the unpredictable British weather (DE032). To take one example, a waste mapping exercise conducted by the consultancy firm SA Partners with the retailer Marks & Spencer found that for a specific chilled product line (a steak ready-meal for one), the greatest impact resulted from the product going ‘Out of Life’ while in the store (Figure 92).

![Figure 92: Financial impacts of waste across the supply chain for a Marks & Spencer ready meal.](image)

Other key challenges for the retailers include loss of revenue from theft and damage; ‘shrinkage’, as it is known, can account for up to 1.5% of revenue (4 p. 3).

### 1.2 Distribution and logistics

Distribution and logistics services represent a crucial link in the modern food supply chain; they ‘focus on the movement of goods and the flow of information from one point in the supply chain to another, with the aim of meeting the demand requirements of the final customer’ (2 p. 13). Their main functions include:

- warehousing
- transportation (by air, rail, road and sea)
- inventory management
- systems control

---

160 In the EU, 44% of freight transport is by road, 41% is by ship and 0.7% by air (35)
strategic management.

Drawing a distinction between the retail and the distribution sub-sectors is not straightforward – and may not be sensible: retailers now seek to control and centralise distribution whenever possible, channelling and consolidating goods into their own regional distribution centres (RDCs) so as to reduce costs (2), which can amount to ‘12-15% of total costs in most food chains’. (4 p. 26) At the same time, however, retailers may outsource distribution activities to third party providers; prominent examples of the latter include Christian Salvesen, Exel and Wincanton (2).

The primary challenge for distribution and logistics operations is to transport produce from farmer to manufacturer - and from manufacturer to retail outlet – in the most fuel- and time-efficient manner while at the same time protecting stock. (NB. The available evidence reviewed in this report primarily concerns distribution of finished products from manufacturer to retailer or wholesaler.)

Crucially, products need to be delivered to the right place, in the right quantities and at the right time. Waste starts to occur whenever these imperatives are not achieved – perhaps due to problems with information systems. Typically, the problem manifests itself with a build-up of inventory (i.e. a stockpile). For instance Value Stream Mapping by the Food Chain Centre (introduced in Section 4.4) found for the dairy sector that even where ‘products have a short life, inventory can accumulate between the processor and retailer … 3 days’ worth of stock is not unusual and for longer life products, stocks can be greater than 10 days … If products are over-ordered, they cause a stockpile and may need to be heavily discounted to clear the stock’ (4 p. 24).

For certain products, especially frozen, chilled and/or short shelf-life foods, adequately managing temperature, humidity, and ethylene levels is also a key challenge (7 p. 16). For example, dairy products ‘need to be chilled throughout the chain and if there are any major temperature control faults, all of the product involved must be discarded’ (4 p. 23).

Growth in the use of transit packaging (e.g. pallets, slip-sheets, shrink-wrap, etc.) has also become a growing source of costs and waste in distribution. Recent years have seen initiatives to reduce this through the use of RTP (returnable transit packaging), secondary/tertiary packaging reduction and, especially for the delivery of raw materials to processors, bulk delivery formats. Little evidence is available, though, for Lean thinking being employed to address transit packaging beyond that presented in Section 5.4 on Behavioural Enablers.

An enduring challenge for the distribution sector is capacity utilisation. According to a 2005 report, ‘Industry wide analysis has shown that food distribution lorries spend only 28% of their time on the road and 20% of vehicle miles are empty’. (4 p. 3) As discussed in Section 4.6, these findings are supported by an academic interviewed for this project who reports that the average loading of a 40 tonne lorry in the UK is currently ‘just 27%’. (DE036)

In recent years, the introduction of RFID (Radio Frequency Identification) technology has revolutionised distribution operations, providing manufacturers, retailers and third party logistics companies with real-time synchronized data on stock items flowing through the supply chain. Assuming they can be adapted appropriately, such advances promise to play a pivotal role in addressing wastes in the supply chain – especially those associated with incorrect demand forecasting161.

As with the Retail sub-sector, reducing product losses due to theft and damage from mishandling is a challenge to distribution and logistics operations. (4 p. 31)

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161 The use of RFID and related technologies are arguably out of the scope of this project given the significant capital investment necessary which may be unavailable to – or inappropriate for – many businesses (especially SMEs).
1.3 **Wholesale**

Wholesalers are also within the scope of this report, although negligible evidence of Lean activities was found in the literature review. They ‘form an essential component of the supply chain, connecting the supply activities (agriculture and manufacturing) with the market activities (retailing as well as catering and public sector procurement) ... The main services provided at this stage are warehousing, transportation, product consolidation, inventory management and retail/catering advisory services’ (p. 17).

According to WRAP’s 2011 *Fruit and vegetable resource maps*, the UK has ‘26 fresh produce wholesale markets in the UK with an estimated turnover of £2.4 billion. In addition, there are 200 wholesale and foodservice companies at independent locations with an estimated turnover of £1 billion’ (p. 17). Food wholesale is a ‘less resource-intensive stage in the supply chain than food processing’ and like the retail sub-sector is ‘often dominated by large enterprises’ (p. 87). Leading players include Booker, Makro, Brakes, Costco and P&H (8).
2 The Nature of the Evidence

A preliminary review of material for this report quickly revealed that very little literature concerning the retail sector explicitly uses Lean terminology; latter tends to be used far more regularly in the manufacturing and filling sub-sectors. The interviews conducted for this project generally also bore this out. For example, one major retailer confidently reported that his company did not use any Lean tools (DE020). Similarly, an interviewee working with a section of the wholesale fruit and vegetable sector remarks that to date his efforts to promote take-up of Lean tools by these businesses have failed. He found that market companies are more interested in boosting web presence and developing relationships with new customers and that ‘Lean does not feature on their radar’ – even when couched in terms of efficiency savings (DE024).

In fact, the language of Lean can actually have a negative connotation. The manager of a continuous improvement team at a leading UK retailer explained that the team’s name was changed recently from the ‘Lean Team’ to the ‘Simple Team’ as shop employees were concerned that the Lean Team’s purpose was ‘to cut their hours’. He stresses to his colleagues that the Simple Team is ‘about reducing the non-value added tasks and making things easier’ (DE034).

As the examples in Section 4 show, a reasonable amount of activity is being conducted that employs at least the components of basic Lean thinking, i.e. measurement, target-setting, etc. Moreover, the possibility should not be excluded that far more ‘true’ Lean processes are being used by retailers that simply have not been reported in published literature for fear of ‘giving away trade secrets’ to the competition. Tellingly, much of the evidence available for review, especially in sources such as CSR reports, concerns progress towards targets (e.g. cutting greenhouse gas emissions) rather than the processes used to achieve them.

Limited published evidence was found on Lean thinking in the distribution and wholesale sub-sectors. In the case of distribution this lack of evidence is perhaps less of a concern as little waste tends to arise during transportation162 – although it is arguable that the distribution function offers the greatest opportunity for waste minimisation given the problems of demand amplification and need for greater supply chain visibility. More worrying is the lack of data on Lean thinking among wholesalers where large quantities of food and packaging waste and other resource inefficiencies are likely to arise; as recommended in Section 6.3, further research will be needed to fill this data gap.

---

162 According to a 2010 report for WRAP, the distribution stage of the UK food and drink supply chain accounts for 0.5% of total waste arisings. [33]
3 Impact Identification

3.1 General impacts/non-hotspots

The retail, wholesale and distribution sub-sectors make a modest but significant contribution to overall energy use and greenhouse gas emissions in the UK food chain. According to Defra’s Food Statistics Pocketbook, in 2007 retail accounted for around 11% of total primary energy consumption and 7% of total greenhouse gas emissions. Lighting and heating are together responsible for almost two-thirds of energy consumption by retailers and could be considered hotspots.\(^{163}\)

Distribution (transport) accounts for about 12% of primary energy use in the food supply chain and about 9% (15 MtCO\(_2\)e per annum) of greenhouse gas emissions. Around half of the emissions come from road freight, followed by consumers’ transport, sea and air freight. Air freight could be considered a hotspot for the distribution sub-sector given that it is responsible for 13% of food transport greenhouse gas emissions despite accounting for just 0.1% of total vehicle miles. Key drivers of emissions in the distribution sector include those associated with ‘cold storage and temperature controlled transport’ and transport emissions ‘particularly as the reliance on imported products increases’ (7 p. 74).

About 8% of total UK food chain waste, put at 18-20Mtpa, arises within retail. Estimates from the 2009 C&I Waste Survey put waste arisings in the sector at 11.2 Mt of which around 10% can be attributed to grocery retail. According to these data, a trend of increasing waste arisings in the retail and wholesale sector has been halted and begun a reversal. Within grocery retail waste, cardboard (61%) and food (24%) account for the largest proportions of waste arising and could be considered hotspots.

The retail, wholesale and distribution sub-sectors have relatively small impacts in terms of other resources. For instance, retail accounts for just 3% of total water consumption across the UK food chain.\(^ {164}\) Emissions to air (other than carbon emissions) have been declining over recent decades from food transport, particularly for particulate matter and nitrogen oxides.\(^ {165}\)

By far the greatest low or no cost resource efficiency opportunities available to the retail, wholesale and distribution sub-sectors are seen for energy use within food distribution where more than £700m in annual savings have been estimated.\(^ {166}\) Key opportunities include: using greater capacity vehicles, changing engine specifications, transport collaboration and driver training (9). Energy efficiency also represents the greatest savings opportunity for retail with improvements to carbon and energy management, and building energy efficiency being recommended areas for action. (10) According to the Carbon Trust almost half of the energy efficiency savings opportunity is available to smaller companies (10 p. 20).

3.2 Hotspots

The previous section identifies the following as being the most significant areas in terms of environmental impacts and resource efficiency opportunities:

- Distribution: fuel (greenhouse gas emissions & energy)
- Retail/wholesale: lighting and heating (greenhouse gas emissions & energy); cardboard (waste, resources); food (waste, resources).

Table 51 presents possible underlying causes of the hotspots (some of which were discussed in the related module FO0425-P1-Hotspots and the corresponding section of the Phase 1 Report), the contexts within which

\(^{163}\) DECC (2011), Energy Consumption in the UK, Service Sector Data Tables
\(^{165}\) Defra (2011), Food Transport Indicators to 2009/10
\(^{166}\) Food distribution has been assumed to represent 26% of total freight opportunity – data taken from (34)
the causative factors operate, and examples of initiatives to address the hotspots. The final column identifies, where known, the type of Lean thinking employed in these activities.
### Table 51: Summary of actions aimed at tackling hotspots in the retail, wholesale and distribution sub-sectors

<table>
<thead>
<tr>
<th>Sub-sector</th>
<th>Hotspot</th>
<th>Food type</th>
<th>Root Cause (s)</th>
<th>Context</th>
<th>Example(s) of action to address</th>
<th>Lean content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution</td>
<td>Fuel</td>
<td>All</td>
<td>Inefficient logistics management Inefficient refrigeration &amp; leaks Poor driving behaviour</td>
<td>Lengthening transit times Cold storage and transport Rising fuel prices</td>
<td>Supplier engagement Reducing transport legs, better warehouse layout, computerised systems Driver training</td>
<td>Continuous improvement Measurement VSM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Appointee of champions Supplier engagement Sharing best practice on carbon reduction Carbon footprinting and targets</td>
<td>Continuous improvement Measurement Targets/KPIs</td>
</tr>
<tr>
<td>Retail &amp; Wholesale</td>
<td>Lighting &amp; heating (&amp; refrigeration)</td>
<td>All</td>
<td>Outdated lighting systems Inefficient refrigeration &amp; leaks</td>
<td>Lighting makes products appear fresher 24 hour shopping In-store refrigerators must be open to enable consumers to view products</td>
<td>Appointment of champions Supplier engagement Sharing best practice on carbon reduction Carbon footprinting and targets</td>
<td>Continuous improvement Measurement Targets/KPIs</td>
</tr>
<tr>
<td>Cardboard waste</td>
<td></td>
<td>All</td>
<td>Over-packaging</td>
<td>Need to protect goods in transit</td>
<td>Introducing RTP Targets</td>
<td>Targets/KPIs</td>
</tr>
<tr>
<td>Food waste</td>
<td>All – especially short-shelf life products</td>
<td></td>
<td>Incorrect demand forecasting leading to over-ordering and demand amplification</td>
<td>Imperative of on-shelf availability Promotions – especially when short-shelf life products Weather fluctuations &amp; extraordinary events Rising consumer demand for ‘fresh’ and varied produce Price competition Long transit times</td>
<td>Measuring waste weekly Supplier engagement Inventory reduction for fruit and veg Planned use of air freight to shorten lead times for products with unpredictable demand</td>
<td>Measurement Targets/KPIs</td>
</tr>
<tr>
<td>Food waste</td>
<td>All – especially fresh produce</td>
<td></td>
<td>Rejection for Cosmetic Reasons</td>
<td>Natural variability of raw materials Damage from by employees or shoppers</td>
<td>None identified</td>
<td></td>
</tr>
<tr>
<td>Food waste</td>
<td>Damaged product</td>
<td></td>
<td>Damage from by employees or shoppers Inadequate handling, temperature management (e.g. Old refrigeration systems) in transit Inadequate packaging</td>
<td>Auditing product loss due to damage in the supply chain</td>
<td>VSM</td>
<td>DMAIC/6-Sigma</td>
</tr>
</tbody>
</table>

Sources (include): (1) (2) (7)
4 Example Lean Actions

4.1 Kaizen & Continuous Improvement

In the literature reviewed for this project, no evidence was found for kaizen explicitly being used by the retail, wholesale and distribution sub-sectors to tackle environmental impacts. However, the basic concept of Continuous Improvement is sometimes seen. Examples of “waste minimisation”-type, in-company, activities include the following:

- WRAP’s 2011 Fruit and vegetable resource maps reports that ‘some organisations promoted a culture of waste reduction (often because they focused on continuous improvement using Lean manufacturing principles) and this culture was driving all other activities in the organisation, such as training, performance measurement and incentives’ (7 pp. 3-4). Unfortunately, further detail on the ‘Lean manufacturing principles’ was not offered.
- M&S, Morrisons, Sainsbury’s, Tesco and the Co-operative train staff to act as ‘in-store energy champions’, empowering them to come forward with proposals ‘to make their store or distribution centre more energy efficient.’ The 2010 Progress Report of A Better Retailing Climate states that ‘changes in behaviour by colleagues in the workplace have helped achieve the 18 per cent reduction in energy-related emissions from buildings since 2005’ (11), although how much of these savings results directly from ‘champions’ programmes is unclear.
- In 2006, Sainsbury’s established the Sainsbury’s Dairy Development Group (SDDG) engaging with 334 milk producers (i.e. farmers) to reduce environmental impact through a “monitor, review and improve” cycle, which is driving continual improvement and carbon reduction – core elements of a Lean thinking approach. The aims of the SDDG - ‘welcomed and endorsed by all including the NFU and DairyCo’ (12 p. 27) - were ‘to improve communication, efficiency and innovation between Sainsbury’s, its processors and its producers through initiatives. Through each initiative, the value added must be greater than the cost’ (12 p. 27). Sainsbury’s claims that between 2007 and 2010, the SDDG achieved direct savings of 8,500 tCO\textsubscript{2}e (worth £1.2 million) through improved farming efficiencies and indirect savings of 36,757 tCO\textsubscript{2}e by reducing calving intervals, improved fuel efficiencies and reduced fertiliser usage (13 p. 27).
- Continuous Improvement is a key theme of the Supplier Exchange programmes established by Marks & Spencer which are ‘designed to reduce carbon emissions from factories and farming. The results will be used to underpin some of our new Plan A commitments for 2010 onwards’ (14 p. 6). The retailer is also working with its suppliers ‘to understand how we can improve the efficiency of their deliveries to our distribution centres, including increasing the use of rail transport by 2012’; in 2010 it reports that it had ‘set up a team who are dedicated to helping Food suppliers improve efficiency and reduce costs when they re-tender their transport contracts’ (14 p. 24), although no results are currently available. Marks & Spencer has also used the Supplier Exchange ‘to develop a Food Supplier Environmental Sustainability Framework’ (14 p. 24), and has worked with suppliers to improve stock planning through the development of more accurate systems for forecasting demand (15 p. 8).
- Similarly, Tesco has set up ‘a Knowledge Hub, an electronic space to share best practice with our suppliers on a daily basis to help them gain the confidence they need to invest in carbon reduction’. The Knowledge Hub currently has over 150 members, and the retailer aims to ‘increase this to 300 in 2011/12’ (16 p. 31).

Although the literature lacked references to ‘kaizen’ specifically, a leading Lean consultancy firm interviewed for this project reports that some of its retail clients do sometimes use kaizen techniques, which in his opinion was a very basic process whereby people meet up, decide where the most important
improvements need to be made and then devise a strategy to implement them (DE028). A good example of this was offered by the manager of a leading retailer’s Simple Team (referred to in Section 0). The Team noticed considerable time being wasted by shop employees checking product codes first thing in the morning (e.g. 6am). Codes are checked to identify which stock is due to expire within 14-16 hours and thus should be marked down in price to maximise sale. The Team changed the code checking process to 3 or 4pm which reduced the amount of time spent checking (as fewer products needed to be checked by then) and reduced financial losses from unnecessary price reductions. Quantitative data on the savings realised may be forthcoming (DE034).

Table 52 summarises the evidence for the use of kaizen and continuous improvement in the food retail and distribution sector.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various (in-company)</td>
<td>Agriculture, Retail, Distribution</td>
<td>Organisations in fruit and veg supply chain focused on CI using Lean manufacturing principles</td>
<td>Waste</td>
<td>n/a</td>
<td>Culture (driving training, performance measurement, incentives)</td>
<td></td>
<td>(7) (2011)</td>
</tr>
<tr>
<td>Various (in-company)</td>
<td>Retail</td>
<td>In-store energy champions appointed</td>
<td>Energy</td>
<td>18% reduction in energy-related emissions from buildings between 2005 and 2010</td>
<td>Staff engagement/champions; VA (A Better Retailing Climate; CRC Energy Efficiency Scheme)</td>
<td>Lack of ownership over estate; location of stores in older buildings or shared space</td>
<td>(11) (2010)</td>
</tr>
<tr>
<td>Sainsbury’s (supply chain)</td>
<td>Agriculture, Retail, Distribution</td>
<td>Sainsbury’s Dairy Development Group established with milk producers to reduce environmental impact through a “monitor, review and improve” cycle</td>
<td>Various</td>
<td>£1.2m direct savings between 2007 and 2010; 8,500 tCO$_2$e (direct) &amp; 36,757 tCO$_2$e (indirect)</td>
<td>Trade Association support (NFU and DairyCo)</td>
<td>(12) (2008); (13) (2011)</td>
<td></td>
</tr>
<tr>
<td>Marks &amp; Spencer (supply chain)</td>
<td>Agriculture, Retail, Distribution</td>
<td>‘Supplier Exchange’ programmes established to reduce carbon emissions from factories and farming and improve distribution efficiency, increasing rail transport</td>
<td>GHG</td>
<td>n/a</td>
<td>VA/CSR (Plan A); Financial savings; External support (NGOs, consultants, Government agencies)</td>
<td></td>
<td>(14) (2010)</td>
</tr>
<tr>
<td>Tesco (supply chain)</td>
<td>Agriculture, Retail, Distribution</td>
<td>‘Knowledge Hub’ established to share best practice with suppliers; looking to double membership to 300 by 2011/12</td>
<td>Various</td>
<td>n/a</td>
<td>n/a</td>
<td>●</td>
<td>● (16) (2011)</td>
</tr>
<tr>
<td>Unidentified (in-company)</td>
<td>Retail</td>
<td>‘Simple Team’ established to identify and improve efficiency – e.g. changing stock code checking practice</td>
<td>Waste</td>
<td>n/a</td>
<td>Staff engagement/champions</td>
<td></td>
<td>(DE034) (2011)</td>
</tr>
</tbody>
</table>
4.2 Measurement

In the literature reviewed, measurement, monitoring and the use of metrics was the most obvious manifestation of Lean thinking in the retail, wholesale and distribution sub-sectors - even though the terminology of Lean was rarely, if ever, explicitly referenced. A mix of within-company (waste minimisation) and whole chain (clean operations) measurement activities was seen.

The measurement of greenhouse gas emissions was probably the most commonly evidenced activity. Examples include:

- As part of Plan A, the retailer Marks & Spencer worked with the Carbon Trust in 2007 to calculate the footprint of all the food it sells ‘at 3.3 million tonnes of CO$_2$e’ (14 p. 24). It has now set targets to reduce CO$_2$ emissions by 2012.
- The Co-operative Group also worked with the Carbon Trust and used PAS 2050 methodology to calculate the carbon impact of their strawberries depending on variety, growing conditions and origin (7).
- According to WRAP’s 2011 Fruit and Vegetable Resource Maps the fresh produce industry is ‘putting in place measures to achieve food production in a low carbon world [including] calculating GHG emissions...’ (7 p. 74).
- As part of the Dairy Roadmap launched in 2008, some multiple retailers (e.g. Asda, Marks & Spencer, The Co-operative, Tesco, Waitrose) have undertaken – or are planning - carbon footprinting exercises with their milk suppliers and sharing benchmarking information within their respective supplier groups (13).
- WRAP’s 2011 Resource Maps for Fresh Meat across Retail and Wholesale Supply Chains notes that Sainsbury’s ‘plans to extend its CO$_2$ audit of dairy farmers to include beef, lamb, pigs and poultry...’ (1 p. 68).
- According to a 2009 business survey ‘big retailers like Wal-Mart are pushing for Greenhouse Gas disclosure from their suppliers’ (17 p. 63).

Some evidence is seen of energy use measurement. Examples include:

- According to the 2010 Progress Report of the voluntary initiative A Better Retailing Climate, the Co-operative, Morrisons and Waitrose are among signatory companies installing ‘automated meter readers across substantial proportions of their estates over the last year’ (11). In many cases, these devices are linked to systems regulating store temperature and lighting. Other activities include the use of low energy lighting in stores and distribution centres (Asda) and refrigerator blinds to reduce overnight energy usage (Co-operative, Sainsbury’s). Energy savings of between 5 and 45% have been reported as a result of these initiatives (11).

Water use measurement is also starting to be seen in the retail, wholesale and distribution sub-sectors. Examples include the following:

- Measurement of water use is another element of A Better Retailing Climate with an estimated 80% of water use measured in 2010 compared with 45% in 2005, although, the savings resulting from this are not known (11).
- The retailer Marks & Spencer pledged to measure accurately its own water use as part of Plan A, however reported in 2010 that this ‘is proving difficult ... because at many locations we have to rely on estimated bills’ (14 p. 2).
- As part of the Dairy Roadmap launched in 2008, several retailers (e.g. The Co-operative, Tesco) are undertaking water audits with their milk suppliers (13).
- Other examples of measurement cited in the literature – either of a mixture of resources or where the resources are not specified include the following:
In 2011, Asda reported that it is working with ‘WRAP in the Product Research Forum, a cross-industry group reviewing common sustainability metrics’ and that it has ‘carried out a lifecycle assessment across milk, lamb, potatoes, chicken and eggs and [has] plans to continue this work under a new Walmart project to eliminate 20 million tonnes of supply chain carbon by the end of 2015’ (18 p. 6).

Under Plan A, Marks & Spencer has appointed and trained ‘Plan A Champions’ in all stores and offices. The Champions, supported with ‘best practice guidance’, report monthly on measurements such as ‘carrier bag usage, clothes hanger recycling and energy consumption that can be easily monitored and actions taken if required’ (14 p. 37).

Surprisingly, the measurement of food and packaging waste remains uncommon in the retail, wholesale and distribution sub-sectors judging by the available literature; for instance, WRAP’s 2011 Resource Maps for Fish across Retail & Wholesale Supply Chains found that ‘the six multiple retailers’ who participated ‘do not routinely monitor the quantity of fish products that are sent for final disposal ...’ (19 p. 7). Some examples of waste measurement nevertheless include the following:

- According to WRAP’s 2011 Resource Maps for Fresh Meat across Retail and Wholesale Supply Chains retailers measure wastage (motivated by Integrated Pollution Prevention and Control (IPPC) Regulations and the Courtauld Commitment) but details of the waste by species or product was not available. The authors call for ‘more effort ... to make this information readily obtainable from retailer and supplier order management systems, and to ensure that it is more widely understood within the industry, using tonnes as a common metric’ (1 p. 4).

- WRAP’s 2011 Fruit and Vegetable Resource Maps reports that one retailer reduced waste over the busy Christmas period by £5 million in 2008 ‘by better controlling the code life of the product and by better management along the supply chain. To do this, they created a matrix across all products sold from the start of December to mid-January’ (7 p. 68). However, the project team on the Fruit and Vegetable Resource Maps was unable to collect tonnage figures for loss and waste identified because ‘companies either regarded the data as commercially sensitive or because, in some instances, tonnages were simply not known ...’ (7 pp. 26-27).

Table 53 summarises the evidence for the use of measurement in the food retail and distribution sector.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marks &amp; Spencer</td>
<td>Retail</td>
<td>Calculated footprint of all food sold at 3.3 MtCO₂e</td>
<td>GHG n/a</td>
<td>VA/CSR (Plan A); External support (Carbon Trust); Financial savings</td>
<td></td>
<td>(14) (2010)</td>
<td></td>
</tr>
<tr>
<td>Co-operative Group</td>
<td>Retail</td>
<td>Calculated carbon impact of their strawberries</td>
<td>GHG n/a</td>
<td>External support (Carbon Trust), Standards (PAS 2050)</td>
<td></td>
<td>(7) (2011)</td>
<td></td>
</tr>
<tr>
<td>Various (supply chain)</td>
<td>Agriculture, Retail, Distribution</td>
<td>The fresh produce industry calculating GHG emissions from food production</td>
<td>GHG n/a</td>
<td>n/a</td>
<td></td>
<td>(7) (2011)</td>
<td></td>
</tr>
<tr>
<td>Various (supply chain)</td>
<td>Agriculture, Retail, Distribution</td>
<td>Multiple retailers carbon footprinting with milk suppliers and sharing benchmarking information within their respective supplier groups.</td>
<td>GHG n/a</td>
<td>VA (Dairy Roadmap); External support (Defra funding); CSR (e.g. for the Co-operative)</td>
<td></td>
<td>(13) (2011)</td>
<td></td>
</tr>
<tr>
<td>Sainsbury’s</td>
<td>Agriculture, Retail</td>
<td>Plan to extend CO₂ audit of dairy farmers to include meat production</td>
<td>GHG n/a</td>
<td>n/a</td>
<td></td>
<td>(1) (2011)</td>
<td></td>
</tr>
<tr>
<td>Company</td>
<td>Sector(s) impacted</td>
<td>Description</td>
<td>Target resources</td>
<td>Savings</td>
<td>Drivers/ Facilitators</td>
<td>Barriers (if specified)</td>
<td>Source (Year)</td>
</tr>
<tr>
<td>---------</td>
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<td>-----------------------</td>
<td>------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Wal-Mart (supply chain)</td>
<td>Agriculture, Retail, Distribution</td>
<td>Greenhouse gas disclosure from suppliers now demanded</td>
<td>GHG</td>
<td>n/a</td>
<td>VA (A Better Retailing Climate; CRC Energy Efficiency Scheme)</td>
<td>Lack of ownership over estate; location of stores in older buildings or shared space</td>
<td>(17) (2009)</td>
</tr>
<tr>
<td>Various (in-company)</td>
<td>Retail</td>
<td>Installation of automated meter readers across estates; linked to systems regulating store temperature &amp; lighting</td>
<td>Energy</td>
<td>5% - 45% energy saving reported (including other initiatives e.g. low energy lighting, refrigerator blinds)</td>
<td>VA (A Better Retailing Climate)</td>
<td>Lack of ownership over estate; location of stores in older buildings or shared space</td>
<td>(11) (2010)</td>
</tr>
<tr>
<td>Various (in-company)</td>
<td>Retail</td>
<td>Measurement of water use (increase in measurement from 45% in 2005 to 80% in 2010)</td>
<td>Water</td>
<td>n/a</td>
<td>VA (A Better Retailing Climate)</td>
<td>Lack of ownership over estate; location of stores in older buildings or shared space</td>
<td>(11) (2010)</td>
</tr>
<tr>
<td>Marks &amp; Spencer (in-company)</td>
<td>Retail</td>
<td>Pledge to measure water</td>
<td>Water</td>
<td>n/a</td>
<td>VA/CSR (Plan A); Financial savings; External support (NGOs, consultants, Government agencies)</td>
<td>Reliance on estimated bills</td>
<td>(14) (2010)</td>
</tr>
<tr>
<td>Various (supply chain)</td>
<td>Agriculture, Retail, Distribution</td>
<td>Water audits with milk suppliers</td>
<td>Water</td>
<td>n/a</td>
<td>VA (Dairy Roadmap; External support (Defra funding))</td>
<td>VA/CSR (Plan A); Financial savings; External support (NGOs, consultants, Government agencies)</td>
<td>(13) (2011)</td>
</tr>
<tr>
<td>Asda/ Walmart (supply chain)</td>
<td>Retail</td>
<td>Reviewing common sustainability metrics and lifecycle assessments across milk, lamb, potatoes, chicken and eggs. Part of Walmart project to cut 20 MtCO₂e by end 2015</td>
<td>Various</td>
<td>n/a</td>
<td>External support (WRAP and Product Research Forum)</td>
<td>External support (WRAP and Product Research Forum)</td>
<td>(18) (2011)</td>
</tr>
<tr>
<td>Marks &amp; Spencer (in-company)</td>
<td>Retail</td>
<td>Plan A Champions report measurements (e.g. carrier bag usage &amp; energy consumption)</td>
<td>Various</td>
<td>n/a</td>
<td>VA/CSR (Plan A); Financial savings; External support (NGOs, consultants, Government agencies)</td>
<td>Financial savings; External support (NGOs, consultants, Government agencies)</td>
<td>(14) (2010)</td>
</tr>
<tr>
<td>Unidentified (supply chain)</td>
<td>Agriculture, Manufacture &amp; Filling; Distribution; Retail</td>
<td>One retailer reduced waste over Christmas by better control of product code life of the product and supply chain management. Facilitated by matrix created of all products sold from Dec. to mid-Jan</td>
<td>Various</td>
<td>£5M saved in 2008</td>
<td>n/a</td>
<td>n/a</td>
<td>(7) (2011)</td>
</tr>
</tbody>
</table>
4.3 KPIs & Targets

The setting of resource efficiency targets, i.e. devising and striving towards a desired future state, is another aspect of Lean thinking increasingly evidenced in the retail, wholesale and distribution sub-sectors; although again, the work conducted is never couched in Lean terminology. Target-setting is closely linked with measurement (as discussed in the previous section), with one practice often driving the other. Again targets may be set for whole supply chains (clean operations) or within companies only (waste minimisation).

Greenhouse gas emissions are most frequently the subject of target-setting. Examples include the following:

- Sainsbury’s ‘plans to extend its CO₂ audit of dairy farmers to include beef, lamb, pigs and poultry….’ In due course, all suppliers will be issued with a 'traffic light' report, which indicates where they rank compared to other suppliers. The supplier is shown whether they are in the bottom 25%, the middle 50% or the top 25% in terms of their carbon footprint. The report also provides feedback and recommendations for cutting emissions and achieving cost savings (1 p. 68).
- One of the three targets of Phase 2 of the Courtauld Commitment (CC2) which runs from March 2010 until December 2012, is to reduce the carbon impact of all grocery packaging by 10% (measured against a 2009 baseline) through reducing the weight, increasing recycling rates and increasing the recycled content as appropriate.
- In 2010, retailer signatories to the voluntary initiative A Better Retailing Climate - many of whom are food retailers – cut their energy-related transport CO₂e emissions from store deliveries by 18% compared with 2005 levels – exceeding a 15% targeted reduction and achieved three years early. The emissions reductions were achieved through ‘re-designing distribution networks, using more efficient vehicles, and sharing loads where feasible.’ (However, it should be noted that overall fuel usage increased by approximately 4 per cent as the volume of goods transported increased.) A Better Retailing Climate also targeted a 25% reduction in energy-related emissions from buildings by 2013 – and again signatory exceeded this achieving an 18% reduction by 2010 (20) (11).
- In 2010 Asda set a goal with parent company Walmart to eliminate 20 million metric tonnes of greenhouse gas emissions from its global supply chain by the end of 2015. The retailer reports that its ‘buyers and energy experts are working with suppliers in more than 20 product categories to identify GHG reduction opportunities, launch new projects and implement changes’ (18 p. 3).
- Tesco claims to have carbon footprinted ‘over 1,000 and labelled over 500 everyday products in the UK’ and has a number of carbon reduction targets: (16 p. 27)
  - By 2012: To halve distribution emissions of each case of goods delivered against a baseline of 2006
  - By 2020: To halve emissions from its 2006/7 baseline portfolio of buildings
  - New stores built between 2007 and 2020 to emit half the CO₂e of a 2006 new store
  - By 2020: To reduce the emissions of the products in its supply chain by 30%
  - By 2050: To become a zero-carbon business by 2050.

Some companies have set energy reduction targets. For instance, the Federation of Wholesale Distributors reports: ‘Wholesale businesses have set stretching targets to reduce their energy usage by as much as 15%. The achievement of these reductions has required every part of the business to contribute, with small actions taken by individual employees often being as important as the changes to facilities made by company management’ (8 p. 5).

Targets relating to reducing packaging waste are sometimes seen, although in recent years the emphasis has been on reducing primary packaging waste, notably through Phase 1 of the Courtauld Commitment and the WRAP-supported lightweighting initiatives. Such activities are beyond the scope of the present

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project given that the impact occurs in households rather than within the supply chain. \(^a\) However, one example would be within scope:

- One of the targets of Phase 2 of the Courtauld Commitment (CC2), running from March 2010 until December 2012, is to reduce traditional grocery product and packaging waste in the grocery supply chain by 5% (measured against a 2009 baseline). This includes both solid and liquid wastes. \(^b\)

Limited evidence is provided on targets set by the retail, wholesale and distribution sub-sectors to reduce food waste within the supply chain. To date, much of the effort has focused on reducing food waste arisings in households. Rare exceptions include the following:

- In written evidence submitted to the UK Parliament in 2011, the retailer Asda outlined some of its goals on improving the resource efficiency of its supply chain including a commitment to ‘[r]educe fresh food waste and utilise unavoidable waste using sustainable methods by 10% farm to fork by the end of 2015’. This would be achieved by investing £99m in perishable supply chain and delivering a program disseminating R&D for beef, pork, lamb, dairy produce, and poultry by the end of 2015 (18 p. 2).
- Tesco’s claim that every ‘store in the UK has waste targets that are reported on a weekly basis’ (16 p. 34).

Although the setting of water use targets by food retailers were not evidenced in the literature, signatories to A Better Retailing Climate committed to a first step towards this, namely to start measuring water use. By 2012, retailers set a goal of measuring water use in sites ‘collectively anticipated as accounting for at least 75% of usage’ by 2012. This was achieved in 2010 with 80% of water use measured (11).

Little evidence is seen in the published literature for the setting of environmental KPIs (key performance indicators). This form of target-setting is most strongly linked to Lean philosophy in that individual managers are often personally engaged and empowered to achieve environmentally-beneficial results. The rare examples include the following:

- Marks & Spencer sets internal targets to boost environmental performance: ‘In 2009/10 we introduced targets for store managers and in 2010/11 these will be linked to payments of performance bonuses’ (14 p. 22).
- According to an evidence review commissioned by Defra in 2011 for waste prevention in the retail sector, ‘[p]art of the success of the Courtauld Commitment is attributed to the fact that it has engaged senior managers and helped incorporate waste prevention into company KPIs’ (15 p. 30). However, it should be noted that the CC1 related to primary packaging reduction and so would be beyond the scope of the present project.
- In 2007, a ‘benchmarking and performance improvement project for distributors in the drinks supply chain sector in England’ took place funded by the Department for Transport with aiming ‘to stimulate efficiency improvements and reduce carbon emissions.’ KPIs were a key aspect of the work (21 p. 15).

However, sales-related KPIs potentially contradict environmental KPIs. For instance, WRAP’s 2011 Resource Maps for Fresh Meat across Retail and Wholesale Supply Chains suggests that store managers ‘are measured on their sales performance, and will trade-off product availability against waste targets.’ However, the authors qualify this pointing out that merchandising standards are generally high, and ‘together with stock rotation, this is only a minor cause of waste’ (1 p. 3).

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\(^a\) An exception would be where lightweighting reduces the weight of primary packaging associated with unsold products disposed of by retailers.

Table 54 summarises the evidence for the use of KPIs and targets in the food retail and distribution sector.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/ Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sainsbury’s (supply</td>
<td>Agriculture, Retail,</td>
<td>Suppliers to be issued with ‘traffic light’ report, which indicates where</td>
<td>GHG</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td>(1) (2011)</td>
</tr>
<tr>
<td>chain)</td>
<td>Distribution</td>
<td>they rank compared to other suppliers in terms of carbon footprint</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Various (supply</td>
<td>Manufacture &amp; Filling;</td>
<td>Target to reduce carbon impact of grocery packaging by 10% between 2009</td>
<td>GHG</td>
<td>n/a</td>
<td>VA (CC2); External</td>
<td></td>
<td>a (2010)</td>
</tr>
<tr>
<td>chain)</td>
<td>Retail</td>
<td>and 2012 through reducing weight and increasing recycling rates and recycled</td>
<td></td>
<td></td>
<td>support (WRAP)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Retail, Distribution</td>
<td>content</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Various (supply</td>
<td>Retail, Distribution</td>
<td>A 15% target for a cut in energy-related transport CO₂e emissions from store</td>
<td>GHG</td>
<td></td>
<td>Staff engagement; VA</td>
<td></td>
<td>(20) (2009);</td>
</tr>
<tr>
<td>chain)</td>
<td></td>
<td>deliveries exceeded 3 years early through re-designing distribution</td>
<td></td>
<td></td>
<td>(A Better Retailing</td>
<td></td>
<td>(11) (2010)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>networks, using more efficient vehicles, and load-sharing</td>
<td></td>
<td></td>
<td>Climate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Various (supply</td>
<td>Retail</td>
<td>A 25% target for reduction in energy-related emissions from buildings by</td>
<td>GHG</td>
<td></td>
<td>Staff engagement; VA</td>
<td></td>
<td>(20) (2009);</td>
</tr>
<tr>
<td>chain)</td>
<td></td>
<td>2013 achieved 3 years early</td>
<td></td>
<td></td>
<td>(A Better Retailing</td>
<td></td>
<td>(11) (2010)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Climate; CRC Energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Efficiency Scheme)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asda/Walmart (supply</td>
<td>Agriculture,</td>
<td>Target to cut 20 mtCO₂e from global supply chain by end 2015, by working</td>
<td>GHG</td>
<td>n/a</td>
<td>External support</td>
<td></td>
<td>(18) (2011)</td>
</tr>
<tr>
<td>chain)</td>
<td>Manufacture &amp; Filling;</td>
<td>with suppliers</td>
<td></td>
<td></td>
<td>(WRAP and Product</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Distribution; Retail</td>
<td></td>
<td></td>
<td></td>
<td>Research Forum)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tesco (supply chain)</td>
<td>Agriculture, Manufacture</td>
<td>Targets: to halve distribution emissions of each case of goods delivered</td>
<td>GHG</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td>(16) (2011)</td>
</tr>
<tr>
<td></td>
<td>&amp; Filling; Distribution;</td>
<td>by 2012 against 2006 baseline; to halve buildings emissions by 2012 from</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Retail</td>
<td>2006/7 baseline; new stores built between 2007 and 2020 to emit half of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2006 new store; to reduce emissions of the products in supply chain by</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30% by 2020; to become a zero-carbon business by 2050</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Various (in-</td>
<td>Distribution</td>
<td>Targets set to reduce energy usage by up to 15%.</td>
<td>Energy</td>
<td>n/a</td>
<td>Staff engagement</td>
<td></td>
<td>(8 p. 8) (Unspecif</td>
</tr>
<tr>
<td>company)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ed year)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Various (supply</td>
<td>Retail</td>
<td>Target to reduce traditional grocery product and packaging waste in the</td>
<td>Waste</td>
<td>n/a</td>
<td>VA (CC2); External</td>
<td></td>
<td>a (2010)</td>
</tr>
<tr>
<td>chain)</td>
<td></td>
<td>grocery supply chain by 5% (against 2009 baseline)</td>
<td></td>
<td></td>
<td>support (WRAP)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/ Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asda (supply chain)</td>
<td>Retail</td>
<td>Commitment to reduce fresh food (meat and dairy) waste by 10% from farm to fork by end of 2015</td>
<td>Waste</td>
<td>n/a</td>
<td>VA (CC2); External support (WRAP); Internal investment and educational programme disseminating R&amp;D info</td>
<td></td>
<td>(18) (2011)</td>
</tr>
<tr>
<td>Tesco (in-company)</td>
<td>Retail</td>
<td>Stores have waste targets that are reported weekly</td>
<td>Waste</td>
<td>n/a</td>
<td>n/a</td>
<td>Lack of ownership over estate; location of stores in older buildings or shared space</td>
<td>(16) (2011)</td>
</tr>
<tr>
<td>Various (supply chain)</td>
<td>Retail</td>
<td>Target to measure water use by 2012 in sites accounting for at least 75% of usage by 2012; target achieved in 2010 with 80% of water use measured</td>
<td>Water</td>
<td>n/a</td>
<td>VA (A Better Retailing Climate)</td>
<td></td>
<td>(11) (2010)</td>
</tr>
<tr>
<td>Marks &amp; Spencer (in-company)</td>
<td>Retail</td>
<td>In 2009/10 environmental performance targets introduced for store managers; in 2010/11 performance linked to bonus payments</td>
<td>Various</td>
<td>n/a</td>
<td>VA/CSR (Plan A); Financial savings; External support (NGOs, consultants, Government agencies)</td>
<td></td>
<td>(14) (2010)</td>
</tr>
</tbody>
</table>

### 4.4 Value Stream Mapping

Value Stream Mapping (VSM)\(^b\) is considered a powerful technique for visualising all the material and information flows required to make a product; this in turns helps identify those processes which add value and those which simply add costs.

In the literature reviewed, almost no evidence was found of VSM in the retail, wholesale and distribution sub-sectors. A notable exception is the work of the Food Chain Centre (FCC) created following the UK Government’s Policy Commission on the Future of Farming and Food (known as the ‘Curry Commission’). Funded mainly by Defra and coordinated by IGD, the FCC ran between 2002 and 2007. As its stated objectives make clear the focus was largely on agriculture: (22)

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\(^b\) Value stream mapping is a lean manufacturing technique used to analyse and design the flow of materials and information required to bring a product or service to a consumer by differentiating value adding from non-value adding steps. It may involve a number of complementary techniques: Process Activity Mapping; Supply chain responsiveness matrix; Product Variety Funnel; Quality filter mapping; Forrester effect mapping; Decision point analysis; Overall Structure Maps.
To develop food chain analyses from farm to point of sale to identify how efficiency savings can be made to the benefit of all players.

To act as a champion for farm benchmarking.

To review consumer research and consider the implications for farming.

According to one interviewee involved with the IGD work, among the larger retailers, most companies had a basic understanding of Lean, although the existing focus prior to IGD’s involvement tended to be on Fast Moving Consumer Goods rather than on applying Lean principles to ‘agri-supply chains’ (DE002).

FCC applied Food Value Chain Analysis (FVCA), a new agri-food specific methodology based on the Lean paradigm, to the red meat, dairy, fresh produce and cereals supply chains (representing English farming’s four largest sectors.) A key element of the FCC work was the creation of what was termed ‘current state maps’ which chart the flow of products and information against a time-line (see Figure 93 for an example).

Following this, ‘ideal’ and ‘future’ state maps were developed setting out long- and medium term visions for improvement. The focus of the FCC work was about understanding what proportion of time was spent on activities which add value – time which could then be saved (23 p. 3). Although financial data were not collected, the time savings could be converted to financial savings later by individual businesses concerned.

Little data on savings actually realised by the FCC work are available – it was more of a demonstration project; however, after examining 33 chains from farm to fork, FCC reported that on average 20% of...
costs in the food chain add no value’ (22 p. 7). An expert involved in the Food Chain Centre claims the programme as a whole “realised £14m in savings, equating to a three-fold rate of return on investment”. He was unable to relate savings to specific measures (DE002).

Interestingly, an 2007 academic paper reporting on the application of FVCA to the chain supplying Tesco with pork found that a collaborative approach involving key players in the supply chain could be effective as long as it was completed in a short time (i.e. within three months) and minimise the use of scarce senior management resource (24).

Although by definition, the FCC work applied to entire chains, some useful learning emerged specifically for the distribution and logistics sub-sectors. For instance, when FVCA was applied to the dairy sector, ‘the distribution of products from dairies onwards was a regular source of opportunity for improvement.’ (25 p. 10) Recommendations included the following:

- Reducing the number of transport legs or steps (e.g. distribution centres) so as to reduce multiple handling and hence risk of ‘product damage and greater instability of demand signals’ (25 p. 11). In addition, food miles may be reduced, ‘a potential “unique selling point”‘ (25 p. 12).
- Improving the layout and handling procedures in distribution depots (In one case it was discovered that 20 milk floats each ran 500 metres per morning within the confines of the depot while loading crates – ‘equivalent of one float driving to the south of France and back each year!’) (25 p. 11).
- Introducing computerised routing and scheduling systems (25 p. 11).
- Measuring Overall Vehicle Efficiency (OVE) – a composite measure accounting for key transport parameters including vehicle availability and performance, etc. (25 p. 12).

An additional reported example comes from the consultancy SA Partners, which worked with the retailer Marks & Spencer to identify the opportunities to reduce waste in the supply of a specific ready meal. A mapping approach was taken to understand exactly where in the supply chain waste arose (Figure 92). The predicted benefits of tackling these wastes include:

- halving food waste
- 15,000 tonne lowering of CO2 emissions
- an 8% cut in costs worth £7.81M
- a 4% sales uplift worth £6.54M.

Another example of a form of VSM being conducted by a retailer was reported by one interviewee, formerly an employee at a large fruit juice manufacturer. He recalled how a major supermarket chain, a customer of the fruit juice company, was running a mapping project of its entire fruit juice supply chain (i.e. factory – local distribution centre (DC) – central DC – stores), to understand precisely where damage was occurring to packaging and product. Unfortunately, information on the results of this project was not available (DE038).

In addition, a major UK retailer reports that having developed KPIs for its supplier base covering such aspects as ‘Technical performance’, ‘Communications’, ‘Logistics’ and ‘Product’ (tracked on a ‘balanced scorecard’), it is now planning VSM to assess where in the supply chain the emphasis should be. This decision was taken following recognition by the retailer that suppliers treated in isolation can only achieve so much’ and that there is a need to integrate operations along the supply chain and to align the KPIs. According to the retailer, the next phase will be ambitious in attempting to manage the supply chain in the manner of the automotive sector: i.e. the retailer will facilitate the feedback of capacity and planning data to avoid such phenomena as demand amplification (DP001).

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Source: Lean & Green Value Chain Analysis. Ready Meals from Butchery to Shelf. SA Partners (2010)
A final example which could be of relevance here comes from the retailer Morrisons which, unusually for a supermarket chain, owns both a slaughterhouse and meat processing plant; this enables meat cuts to be prepared in store allowing Morrisons ‘to react very quickly to changes in customer demand’ (1 p. 72). Such an approach could be considered as value stream integration, although whether VSM was employed to arrive at this Lean solution to reducing product waste is unknown.

Table 55 summarises evidence for the use of VSM in the food retail and distribution sector.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various (supply chain)</td>
<td>Agriculture; Manufacture; Filling; Distribution; Retail</td>
<td>Development by the Food Chain Centre (2002 – 2007) of ‘current’ and ‘ideal state maps’ to improve efficiency of 4 largest UK agricultural sectors</td>
<td>Waste</td>
<td>Whole programme realised £14m savings</td>
<td>External support (Defra funded; coordinated by IGD); Collaborative approach</td>
<td>Limited senior management time (22) (2007); (24) (2007) (DE002) (2011)</td>
<td></td>
</tr>
<tr>
<td>Marks &amp; Spencer (supply chain)</td>
<td>Manufacture &amp; Filling; Distribution; Retail</td>
<td>Opportunities to reduce waste in supply of ready-meal</td>
<td>Waste</td>
<td>Predicted: 50% cut in food waste, 15 ktCO₂e GHG savings; 8% cut in costs (worth £7.81m); 4% sales uplift (worth £6.54m)</td>
<td>External support (SA Partners)</td>
<td>a (2010)</td>
<td></td>
</tr>
<tr>
<td>Unidentified (supply chain)</td>
<td>Agriculture, Manufacture &amp; Filling; Distribution; Retail</td>
<td>Entire fruit juice supply chain mapped to understand where damage to packaging/product occurs</td>
<td>Waste</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td>(DE038) (2011)</td>
</tr>
<tr>
<td>Unidentified (supply chain)</td>
<td>Agriculture, Manufacture &amp; Filling; Distribution; Retail</td>
<td>VSM planned to identify where emphasis should be to improve supplier technical performance, communications, logistics &amp; product; introduction of planning data feedback to demand amplification.</td>
<td>Various</td>
<td>n/a</td>
<td>n/a</td>
<td>Lack of supplier capability or buy-in (DP001) (2011)</td>
<td></td>
</tr>
<tr>
<td>Morrisons</td>
<td>Agriculture, Distribution; Retail</td>
<td>Vertical integration: slaughterhouse and meat processing plant owned by retailer allowing to rapid response to customer demand fluctuation and cut waste; possibly introduced as a result of VSM exercise.</td>
<td>Waste</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td>(1) (2011)</td>
</tr>
</tbody>
</table>

*Source: Lean & Green Value Chain Analysis. Ready Meals from Butchery to Shelf. SA Partners (2010)*
4.5 **Advanced Tools**

From the literature reviewed, few examples of retail, wholesale and distribution sub-sectors using ‘advanced tools’ such as 6-Sigma, 5S, SMED, Kanban were available. This conclusion is in line with the Food Chain Centre research on Lean thinking in the red meat industry which found that ‘the majority of companies participating in the pilot projects had little or no prior knowledge of the latest process improvement concepts (such as Lean or 6-sigma) and techniques at the commencement of the project. This in itself suggests a major opportunity for the industry.’ (23 p. 16)

A rare exception comes from a 2009 academic paper reporting on the results of two supply chain studies conducted in the Australian State of Victoria, one of which focused on the losses in food product distribution due to potentially inadequate packaging. The studies ‘followed a systematic approach based in principle on the DMAIC (Define, Measure, Analyse, Improve and Control) methodology for process improvement projects using 6-Sigma’. (26 p. 1258) The approach is summarised in Table 56.

### Table 56: The DMAIC methodology used for reducing waste in an Australian food chain

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define</td>
<td>The study defined the problem that packaging may be too poorly designed to protect products during transit leading to wastage. Project team established to solve problem.</td>
</tr>
<tr>
<td>Measure</td>
<td>Waste and value loss is assessed for different points in the supply chain. Two product types chosen for further analysis along 4 distribution routes.</td>
</tr>
<tr>
<td>Analyse</td>
<td>Detailed monitoring (e.g. visual and photographic inspection of damage, assessment of communication issues, measurement of the extent of shock exposure using a recording device, temperature fluctuations) conducted during production and transit phase for distribution times ranging from 4 to 18 days. Enhanced data collection using RFID.</td>
</tr>
<tr>
<td>Improve</td>
<td>Recommendations made to improve product integrity during transit based on the consolidation of monitoring data and visual inspection of product handling at transit locations.</td>
</tr>
<tr>
<td>Control</td>
<td>Improvement potentials for packaging integrity and product handling realised by the company.</td>
</tr>
</tbody>
</table>

Source: (26)

Interestingly, this research offers a singular published example of RFID technology being used in an ‘advanced Lean’ project. During the ‘Analyse’ phase ‘[e]nhanced data collection was ... facilitated through the purchase of Radio Frequency Identification logging devices which provided real-time data during distribution.’ (26 p. 1262) Overall, the exercise, which was performed for one frozen product (potato fries) and one ambient (canned corn), achieved ‘lower supply chain costs during transport and distribution and efficiencies due to improved performance of packaging material and handling resulted in reduced losses and rejects by the customer’. (26 p. 1262)

*Table 57 summarises the evidence for the use of advanced tools in the food retail and distribution sector.*
WRAP recently initiated a series of one-to-one collaborations between five major UK retailers (Musgrave, Sainsbury’s, Morrisons, Tesco and Marks & Spencer) and specific suppliers (United Biscuits, World Flowers, Kerry-Noon, MM (UK), Natures Way Foods, and UNIQ). A mixture of Lean-type tools and approaches were used - including ‘mind-mapping’, ‘KPI information gathering’, ‘end-to-end supply chain walk-through’ and ‘process mapping’ - to cut waste arisings in the supply chains. The product categories in focus were: biscuits, snacks, cakes, flowers, ready meals, citrus, salads and sandwiches. The work (coordinated by IGD) ran from December 2009, and by March 2011 had prevented c.1,400 tonnes of waste arising; a further 1,193 tonnes was expected to be prevented in 2011-12. In total, this equates to a 1% reduction in waste as a percent of sales although, at the outset, sustained behaviour change was considered as important as a waste reduction target (ID412).

The reviewed literature offers a handful of other examples of approaches to resource efficiency in the retail, wholesale and distribution sub-sectors which do not involve any of the Lean actions discussed above, but nevertheless bear some of the ‘hallmarks’ of Lean. Minimising inventories (or stockholdings) is an important element of the Lean philosophy, and evidence suggests this already is a driver in the food sector, especially for chilled and other highly perishable products. WRAP’s 2011 Fruit and Vegetable Resource Maps cites a 2007 report by IGD Retail Logistics which found that ‘the stock cover for the main product categories shows that inventories for produce [i.e. fruit and vegetables] have the second lowest inventory level after chilled fresh meats … This IGD study also indicated that the fresh produce category had shown a substantial reduction in inventory levels reflecting the efforts to reduce waste in this area’ (7 p. 16). Figure 94 shows inventory levels for various product categories.

![Figure 94: Inventory levels (stock cover in days) by product category.](source)

Another example comes from Tesco which, in the early 1990s, was one of the first companies in the UK food industry to apply Lean thinking (5 p. 3). The retailer worked with Cardiff University’s Lean Enterprise Research Centre on Leaning new product introduction (NPI), Lean distribution and Lean order fulfilment. The precise methods used are not reported, but the project reduced NPI from 26 weeks to 8 weeks, achieved a 30% increase in overall vehicle effectiveness and introduced ‘1 touch replenishment’ (Figure 95) (27).

Figure 95: Results of a Lean thinking project conducted by Cardiff University and Tesco

A correlation is suggested between the adoption of Lean thinking by Tesco and its profitability – although causation is hard to prove. An interviewee involved in the IGD work reports that the pioneering work by Tesco in the 1990s to implement Lean thinking encouraged the rest of the food industry to follow suit. Tesco worked with universities and others to codify Lean thinking for their sector. The approaches were then cascaded to Tesco’s supply chains (DE002).

An academic and former production manager in the food industry described a project he had advised on involving the distribution of Spanish tomatoes sold by a leading retailer in the UK. Previously, whole orders of tomatoes would be transported by road taking at least three days. However, a change in the weather forecast in the UK (e.g. from sunny to rainy) would often result in a proportion of the order being cancelled 8 hours before it was due leading to significant food waste. Now, the supplier will ship perhaps 80% only of an order by road and then eight hours before the required delivery time the final order will be checked again. If 100% of the order is still needed, the balance will be air-freighted instead – this has led to a significant reduction in waste – although quantitative are not currently available. According to the interviewee, the retailer has analysed the carbon emissions resulting from this new approach to sourcing tomatoes – although the results of this analysis are not known. The specific Lean tools used for this innovation are also unreported, but a kaizen-type continuous improvement approach is likely (DE032).

Interestingly, a different academic with many years’ experience of implementing Lean in the automotive sector disputed whether examples such as the foregoing would count as ‘truly Lean’. He points out that although many large retailers have ‘Leaned’ their supply chains in the sense of ‘increasing the efficiency of distribution, de-stocking and increasing the speed of response’, the trend towards sourcing ever
cheaper goods often results in stock having to be air-freighted in from distant countries, including the developing world. In addition, he argues that pressure for products to be on the shelves – the all-important driver of ‘on-shelf availability’ – frequently results in ‘half empty lorry loads’ and a lack of resilience in the supply chain: ‘Processes can look very Lean on a spreadsheet but if the weather is very hot and demand increases unexpectedly a supermarket may end up having to fly in t-shirts from Tanzania. You need to look at the whole system properly.’ He reports that the average loading of a 40 tonne lorry in the UK is currently ‘just 27%’ (DE036).

Table 58 summarises the evidence for the use of mixed tools in the food retail and distribution sector.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector(s) impacted</th>
<th>Description</th>
<th>Target resources</th>
<th>Savings</th>
<th>Drivers/Facilitators</th>
<th>Barriers (if specified)</th>
<th>Source (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various (supply chain)</td>
<td>Retail; Manufacture; Filling</td>
<td>Collaborations between five major UK retailers and suppliers to cut waste. Lean tools including measurement, KPIs, and process mapping</td>
<td>Waste</td>
<td>Between Dec 2009 &amp; March 2011, c.1.4kt waste prevented; further 1.193kt cut expected in 2011-12; equates to a 1% overall waste reduction</td>
<td>External support (WRAP, IGD); staff engagement &amp; senior management buy-in (financial driver)</td>
<td></td>
<td>(ID412)</td>
</tr>
<tr>
<td>Various (supply chain)</td>
<td>Agriculture, Distribution; Retail</td>
<td>Minimisation of inventories in fruit and vegetable supply chain</td>
<td>Waste</td>
<td>n/a</td>
<td>‘Fear of a lost sale’ leading to overstocking</td>
<td></td>
<td>(7) (2011)</td>
</tr>
<tr>
<td>Tesco (supply chain)</td>
<td>Agriculture, Manufacture &amp; Filling; Distribution; Retail</td>
<td>Leaning of new product introduction (NPI), including Lean distribution and order fulfillment; as well as ‘one-touch replenishment’</td>
<td>Various</td>
<td>NPI time cut from 26 to 8 weeks; 30% increase in vehicle effectiveness</td>
<td>External support (Cardiff University’s Lean Enterprise Research Centre)</td>
<td></td>
<td>(5) (2011); 27 (Unspecified year)</td>
</tr>
<tr>
<td>Unidentified (supply chain)</td>
<td>Agriculture, Distribution; Retail</td>
<td>Introduction of airfreighting for portion of tomato order to improve response to customer demand and weather; thus cutting food waste but while minimising CO2 emissions</td>
<td>Waste, GHG</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td>(DE032) (2011)</td>
</tr>
</tbody>
</table>
5 Behavioural considerations

5.1 Attitudes

An evidence review for Defra on waste prevention in the retail sector notes that ‘a culture change is often required to embed resource efficiency and continuous improvement into organisations so as to move the emphasis away from waste management and towards waste prevention. This needs to be undertaken at the corporate level and requires strong leadership’ (15 p. 28). This view was echoed by a representative from a leading Lean consultancy (which sometimes worked with the retailers) who reported that the ‘mind-set’ of people was crucial: ‘Are they constantly challenging the way things are done?’ (DE028).

Unfortunately, little evidence is available from the literature on corporate attitudes towards Lean thinking in the retail, wholesale and distribution sub-sectors. An exception is the finding – already referred to in Section 4.1 – in WRAP’s 2011 Fruit and Vegetable Resource Maps that ‘some organisations promoted a culture of waste reduction (often because they focused on continuous improvement using Lean manufacturing principles) and this culture was driving all other activities in the organisation, such as training, performance measurement and incentives...’ (7 pp. 3-4).

Discussing its suppliers rather than its own internal corporate attitudes, a well-known UK retailer interviewed for this project reports that it has worked to sell Lean on the basis that it makes those supplier companies ‘great places to work’. The retailer believes strongly that Lean can only be successful with a deep commitment to Lean by key staff within those suppliers (DP001).

5.2 Motivators

Rather more evidence is published on what might motivate retail, wholesale and distribution companies to start to employ Lean thinking.

The opportunity to reduce costs (and boost profits) is likely to be the overriding motivation for retailers undertaking resource efficiency activities – however, whether cost-saving drives Lean thinking per se is less clear-cut. Marks & Spencer reported in 2010 that by improving using less energy, reducing packaging and waste, and creating new markets such as M&S Energy as part of Plan A, it had ‘generated additional profit of £50m for 2009/10, which has been invested back into the business’ (14 p. 3). It notes: ‘Improving the efficiency of our energy use in stores and fuel use in transport reduces our costs. As these resources become more expensive in the future the savings will continue to grow’ (14 p. 6). A different interviewee suggests that the drivers for food companies to adopt Lean thinking has been the well-documented squeeze on household incomes, greater competition and the imperative to remove costs from the supply chain (DE002).

Legislation can also motivate. For instance, the UK Government aim to reduce emissions by 80% by 2050 is cited by Marks & Spencer who report that it has ‘gone even further – committing to make our operations in the UK and the Republic of Ireland carbon neutral and help our customers and suppliers cut their emissions too’ (14 p. 6). But as has now been widely recognised by policy-makers, voluntary agreements (VAs) rather than legislation, seems a better way to drive change – especially with larger, higher profile businesses. Examples include the following:

- A Better Retailing Climate. Launched in April 2008 and coordinated by the British Retail Consortium, it sets out the UK retail sector’s collective environmental ambitions and has engaged 22 leading
retailers accounting for 49% of the UK retail market (11). As the preceding Sections make clear, this agreement has promoted measurement and target-setting among signatories, although does not explicitly drive ‘harder’ Lean approaches. As with other voluntary initiatives, A Better Retailing Climate sets targets and leaves the mechanisms by which these are achieved to individual companies. The initiative’s 2010 Progress Report states that many retailers are also involved in the CRC Energy Efficiency Scheme which further motivates them to focus on efforts to reduce carbon emissions from buildings (11).

- **Courtauld Commitment Phase 2.** As mentioned previously, CC2 is also likely to initiate resource efficiencies across the grocery retail sector; for example, the authors of WRAP’s 2011 Fruit and Vegetable Resource Maps believe it is ‘encouraging more measurement of waste in the food sector’ (7 p. 78). Similarly, WRAP’s 2011 Resource Maps for Fish across Retail & Wholesale Supply Chains reports that retailers are ‘looking to meet demanding targets under the Courtauld Commitment...’ (19 p. 91). However, again, CC2 does not explicitly promote Lean.

- **The Federation House Commitment.** According to WRAP’s 2011 Resource Maps for Fresh Meat across Retail and Wholesale Supply Chains FHC (along with CC2) ‘is providing an impetus to improve data availability’, although the reach of these VAs into the meat industry is said to be low (1 p. 76).

Although data are lacking, other VAs, such as the Food and Drink Federation’s Five-fold Environmental Ambition are likely to be driving Lean thinking.

The Defra-supported Roadmaps approach could also drive moves towards Lean action in the retail, wholesale and distribution sub-sectors. Certainly, these have encouraged far more measurement of impacts. Much of the emphasis of the Dairy Roadmap launched in 2008 is on improvement in the earlier part of the dairy supply chain (with numerous detailed targets aimed at the milk producing and processing stages). The Dairy Roadmap does though set out several general aspirations for retailers – with supply chain engagement a central theme (Table 59). Perhaps the best example of resource efficiencies achieved from the Roadmap approach come from the work of Sainsbury’s Dairy Development Group’ (SDDG) (see Section 4.1). However, it should be noted that Sainsbury’s created SDDG two years prior to the establishment of the Roadmap.

### Table 59: The Dairy Roadmap targets for retailers

<table>
<thead>
<tr>
<th>Target</th>
<th>Short Term Actions: by 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>All major multiple retailers should establish positive, direct (where appropriate) relationships with producers (farmers) and processors. The objectives of these relationships are to improve transparency in the supply chain, communication and efficiency and to agree initiatives to add value and support the delivery of the targets for producers and processors in the Roadmap.</td>
<td></td>
</tr>
<tr>
<td>All major retailers should recognise the work of the Roadmap and, where possible, incorporate targets within their own Corporate Responsibility Targets covering points such as carbon emissions, reduction in energy use, reduction in water use and reduction in waste going to landfill (not an exhaustive list).</td>
<td></td>
</tr>
<tr>
<td>All major retailers should consider the use of technological interventions to reduce CO2 emissions associated with transport of liquid milk.</td>
<td></td>
</tr>
<tr>
<td>Retailers should support supply chain delivery of environmental benefits by reinforcing positive environmental messages for milk through product placement and point of sale information.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medium Term Actions: by 2015</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Retailers should look to reduce emissions from existing retail stores – including new refrigeration technology and interventions.</td>
<td></td>
</tr>
<tr>
<td>All major retailers should explore options to increase the amount of recyclate used, and encourage recyclability, in product packaging from a 2007 baseline to close the recycling loop. They should also invest in ways to recover materials from their customers to</td>
<td></td>
</tr>
</tbody>
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*This includes the entire retail market, not just food retail.*
| **Long Term Actions: by 2020** | Retailers should make visible commitments to support environmental achievements by their suppliers. Retailers should make a commitment that all new stores built between now and 2020 will emit less carbon than an equivalent store in 2006. Source: (12) NB. These targets are subject to adjustment over time. |

As mentioned above, WRAP and IGD recently supported a series of collaborations between retailers and suppliers using Lean-type approaches. The longevity of the innovations piloted in these studies is unclear, although all conclude with a ‘roll-out and sustain’ phase in which the respective project teams applied ‘the improvements to other parts of their businesses, for example other products within the category or other categories.’ The work is designed to support and encourage signatories in meeting the CC2 target of a 5% reduction in product and packaging waste (both solid and liquid) in the grocery supply chain (ID412).

Trade associations can also provide some impetus – often in combination with VAs. For example, an interviewee from a leading trade body representing the entire supply chain for a particular food type reports that since 2008 all his members contribute to a sector-wide environmental benchmarking exercise for various measures (energy, water, waste, packaging, recycling etc.) which revealed the best worst performers, albeit anonymised. The interviewee reported that he was planning to collect examples of best practice among his members in the next 2-3 months so there could be data linking specific Lean approaches to specific outcomes available to the project (DE021).

Another potential driver, especially for larger companies (often behind involvement in VAs), is corporate reputation or image. Pressure from environmental NGOs, media and the buying public can be important although the evidence is poor. Examples include the following:

- A 2006 academic paper on seafood sustainability found reports that ‘[m]ost British supermarkets now have policies like increasing MSC [Marine Stewardship Council]-certified products to meet a target by a specified date’ (29 p. 586). Other examples of US supermarkets working with third sector organisations to improve seafood sustainability are also given.
- According to the Carbon Trust, reputation is a potential driver of energy efficiency performance in large retailers (10 p. 12).
- According to The Co-operative, the foundation for its work with dairy farmers which includes environmental impacts measurements is its ‘own Food Ethical Policy [as well as the Dairy Roadmap] ... with a focus on animal welfare, environmental stewardship and carbon footprint reduction’ (13 p. 27).
- A major UK retailer interviewed for this project was motivated to start working more proactively with its supply chain ‘from a CSR imperative’; it wanted to be seen to be improving wages and living standards in off-shore suppliers, notably in textiles. Environmental concerns followed, addressed by another set of protocols. Ultimately, the retailer adopted a holistic approach joining economic, social and environmental outcomes with Lean providing a ‘framework for eliminating lost value, setting targets and KPIs for suppliers that matched the needs of the retailer as a customer (DP001).

### 5.3 Barriers

Given that little evidence was available in the reviewed literature for ‘true’ Lean activities, it can be difficult to assess confidently what might act as barriers. Clearly, though, for the retail, wholesale and distribution sub-sectors, on-shelf availability is a key driver, almost invariably overriding other goals such as better environmental performance. WRAP’s 2011 Fruit and Vegetable Resource Maps found that underlying many of the causes of waste was the retailers’ imperative to avoid unavailability of produce on their shelves; for many of interviewees, ‘the fear of a lost sale is greater than the fear of waste’ (7 p.
Another potential barrier to the use of Lean thinking in reducing environmental impacts in the grocery sector is the importance of food safety; for instance one retailer interviewed for this project pointed out that when designing packaging, product hygiene is the greatest priority, followed by the need to prolong shelf-life and finally packaging reduction (DE020).

Smaller companies in the retail, wholesale and distribution sub-sectors face other barriers to Lean practice. For instance, according to the 2010 Progress Report of A Better Retailing Climate, improving the energy efficiency of buildings can be difficult for retailers that do not own their own estates or whose stores are located in older buildings and shared space (11). The same report highlights other barriers to improvement including local opposition to infrastructure development and shortages of technicians and engineers skilled in low carbon technology.

For retail, wholesale and distribution sub-sectors, a large proportion of the impacts of any inefficient practices (e.g. incorrect demand forecasting), will arise earlier in the food chain – especially at the manufacturing stage. Thus, it is conceivable that retailers may not feel the same impetus to implement Lean improvements; i.e. the perceived benefits are too low to be worth worrying about. This point is picked up in a 2007 report for EB Evolve EB Limited, whose key message is that a barrier to tackling waste in the food chain is an underestimation of the cost of that waste. The report argues that ‘the true costs, including social and environmental costs, of food waste generation and disposal are not perceived and/or understood by waste producers’ (2 p. iii). This is particularly problematic when retailers, whose decisions may indirectly cause the waste, are not liable for its costs. The recent WRAP & IGD-supported collaborations between retailers and suppliers using Lean-type approaches sought to address this barrier by demonstrating that the programme was ‘of commercial benefit to participating companies ... [which] was critical to both the design and execution of projects’ (ID412).

In the same vein, the Carbon Trust points out that energy costs are often a tiny proportion of overall costs. It estimates that in the retail sector, energy costs represent perhaps 0.1-1% of revenue (versus, for instance, 4-6% in the chemical sector) and a 20% cut in energy costs would increase retailer profit margins by only 0.02-0.2% (10 p. 9). However, interviews conducted for the present project would seem to suggest that rising energy prices are very much motivating companies to explore Lean techniques.

Given that Lean approaches can take time to bear fruit, lack of contracts between retailer and supplier can be another potentially important barrier to progress, according to the Food Chain Centre work on Lean thinking in UK agri-food chains. Retailers will typically be reluctant to commit to long-term relationships with a supplier in order to remain flexible and competitive. FCC reports that ‘[r]etail chains did not have long-term written commitment at retailer/processor or processor/producer (with one exception) level ... Lack of contracts was cited in many chains as a barrier to collaboration and improvement due to the imbalance in risk, and the perception that participants could switch at short notice’ (23 p. 17).

A significant barrier to the success of clean operations-type Lean initiatives engaging supply chains can be lack of capability or 'buy in' by suppliers. A large UK retailer interviewed for this project reported that although a number of its suppliers professed to have adopted Lean, in practice this was not embedded in the culture. For instance, control charts were seen to be 'owned' by the supervisor, not the responsible operator – it was a 'management thing'. The same retailer also points out the risk that improvements achieved by suppliers as a result of the retailer’s efforts could backfire in the sense that competing retailers supplied by the same companies could also enjoy the benefits. This issue is now the subject of internal debate at this retailer (DP001).
5.4 Enablers

Despite the lack of evidence for explicitly Lean activities in the retail, wholesale and distribution sub-sectors, it is possible to highlight some potential examples of success factors enabling or facilitating resource efficiency initiatives.

Prime among these is employee engagement; continuous improvement of business processes is most likely to be successful when the knowledge, experience and skills of those people performing those processes on a daily basis can be harnessed. Examples include the appointment of ‘champions’ by retailers empowering them to come forward with proposals (11). Some cases are discussed in Section 4.1. Further evidence comes from the 2009 academic research conducted in the Australian state of Victoria on the application of 6-Sigma/DMAIC methodology to address supply chain losses, including in the food sector. According to the authors, the ‘projects demonstrated that the company based culture is wasteful of resources and adds costs but that these are generally not visible unless there is a champion within the chain to identify these needs and optimise production processes’ (26 p. 1262).

Linked to this would be supply chain engagement and external support which has characterised many of the Lean activities discussed in this report. Further examples include the following:

- In 2009, Asda created an expert body comprising of Government, NGOs, academics, major brands and the packaging industry. The retailer called this group a SVN (Sustainable Value Network) whose constituent members helped Asda configure a new system enabling future further packaging optimisation. This new ‘packaging scorecard’ will be rolled out in 2011 to both question the packaging used on Asda products by suppliers and also to allow them to model different formats to ensure they select the more environmentally preferable option (18 p. 4).
- Marks & Spencer reports in 2010 that ‘partners such as WWF, Business in the Community, Forum for the Future, RSPCA, Oxfam, Waste Resources Action Programme (WRAP), the Carbon Trust, BRE consultants and Groundwork’ have helped the retailer ‘learn faster and develop better solutions’ (14 p. 3).
- Marks & Spencer’s work on Continuous Improvement through its Supplier Exchange (See Section 4.1). For instance, as part of its zero waste to landfill goal, M&S is working with suppliers ‘to move away from using EPS [expanded polystyrene] fish boxes for transport of fish and, in future, intends all transport packaging to involve the use of polyethylene boxes. These boxes contain some recycled content and are fully recyclable’ (19 p. 90).

The work many retailers (and wholesalers) have undertaken with suppliers to introduce returnable transit packaging. Examples are legion; here are a few: (15 p. 13)

- Boots saved 270 tonnes of cardboard, 200 tonnes of plastic and £125,000 per year by developing a system to re-use plastic transit trays for the display of sandwiches
- Morrisons reported that it exceeded its target of extending returnable tray trips by 14 million in 2008, achieving 17 million trips, and saving 72,000 tonnes of transit packaging
- Musgraves reported that it is working with suppliers to achieve 30% utilisation of re-usable crates on own-brand products
- Sainsbury’s worked with its chilled foods supplier, Tibbett & Britten Group to use re-usable plastic crates, which could be tracked using a ‘smart’ tag system
- The Austrian retailer, Spar, reduced packaging waste by 3,500 tonnes in 2004 by increasing use of RTP from 44% to 51%
- Two regions in Sweden avoided 12,475 tonnes of packaging waste in two years by introducing re-usable crates, and there was an additional reduction of spoiled food due to more robust packaging being used (not quantified)
- Tesco reported that delivering products in re-usable plastic trays saved 20,000 tonnes of cardboard in the UK in 2008
The wholesaler Booker is rolling out re-usable meat trays removing ‘the need for 400,000 cardboard cases saving 500 tonnes of packaging. This will also eliminate food waste caused by damages within the supply chain’ (8 p. 8).

Part of the reported success of the Food Chain Centre work on Lean thinking and VSM in the red meat, dairy, fresh produce and cereals supply chains was the emphasis on ‘learning by doing’ with the businesses involved required to do the work, rather than having consultants brought in to do it for them. ‘In this way,’ note the authors, ‘we were able to encourage teamwork as well as train the individuals that took part’ (23 p. 3).

Interestingly, a representative of one leading retailer interviewed for this project, revealed that while the company could influence the design of transit packaging used by suppliers of own brand products – notably to create ‘shelf-ready packaging’ – it was less successful in changing the processes of ‘big name’ brands to do the same. A tension exists between the retailer who wants secondary packaging to be easy to count, rotate, replenish and look attractive to the consumer, and the manufacturer who wants the packaging to go down the production line quickly, protect goods and not be too expensive (DE034).

The recent WRAP and IGD-supported retailer-supplier collaborations saw the following as key factors facilitating the success of the Lean approaches (ID412):

- providing teams with confidence to innovate
- agreement, documenting and distributing actions, responsibilities and deadlines
- identifying and addressing individuals’ concerns
- capitalising on individuals’ positive feelings
- committing teams to reporting deadlines
- coordination and cross fertilisation amongst teams
- scrutiny and constructive criticism of progress of other teams
- capturing business results and learnings
- sharing success stories/tools with other categories.
6 Learning

6.1 Insights

In terms of root causes, much of the waste (in the sense of suboptimal resource use) in the UK retail, wholesale and distribution sub-sectors seemingly arises from the coincidence of a growing customer demand for an ever-changing selection of ‘fresh’, short shelf-life food products and the stochasticity of that demand, the latter exacerbated by unpredictable weather and other events. Given the dogma that empty shelves and lost sales are ‘worse’ than waste due to overproduction, demand amplification is the typical result. Such factors may underlie the waste arising in other sections of the supply chain, especially in manufacture and filling.

However, these cannot be the whole answer given that, for instance, plenty of waste (in the sense of material failing to reach the customer) is also seen in supply chains for more ‘traditional’, ambient products where demand forecasting is more straightforward and on-time delivery is not such an imperative. Thus, additional factors such as unplanned product promotions as well as product damage due to inadequate packaging and mishandling may also be important.

Evidence was generally scarce for explicitly Lean Thinking in the sub-sectors in question. As WRAP’s 2011 Resource Maps for Fresh Meat across Retail and Wholesale Supply Chains found, examples of ‘Lean manufacturing principles’ being used to improve processes and reduce waste among the businesses analysed were rare (1 p. 4).

However, to conclude that Lean thinking is not occurring would be dangerous. Firstly, the jargon of Lean has traditionally been more a feature of the manufacturing and filling sub-sectors; indeed as has been pointed out, some of the terminology can be viewed negatively as overly complex and may have been ‘toned down’ or dispensed with altogether. Thus literature searches for keywords will not be wholly successful. Perhaps a more important observation is that in the highly aggressive marketplace, retailers and others may simply not wish to publicize details of successful use of Lean approaches for fear of helping the competition.

The take-home message is absence of evidence which is not the same as evidence of absence, and certainly many examples of interventions (supported or independent) which adopt to a greater or lesser extent at least the principles of Lean have though been reported. So while terms such as ‘kaizen’ were absent, plenty of examples are seen of formal continuous improvement actions – among larger retailers in particular. Similarly, the basic and fundamentally important activity of measurement and goal-setting is even more widely evidenced. Environmental impacts increasingly monitored and targeted for reduction in the retail, wholesale and distribution sub-sectors include greenhouse gas emissions, water and energy use, and to a lesser extent food and packaging waste.

Any reading of the published literature indicates that the use of more sophisticated, formal Lean approaches (e.g. VSM, 6-Sigma) is not common practice in the retail, wholesale and distribution sub-sectors. In the rare cases that these tools and techniques have been reported, they tend to have occurred as a result of government-funded initiatives (notably, the Food Chain Centre work from 2002-07 and Defra’s Product Roadmaps). However, as some of the stakeholder engagement is already revealing, a great deal more work is in fact being undertaken, but is simply not being talked about publicly for the reasons given above. It should be borne in mind after all that the retailer Tesco was among the first companies in any section of the food chain (including manufacturers) to adopt formal Lean approaches to improving resource efficiency (and its profits).

In terms of behavioural learning, the examples of Lean thinking presented above indicate that even though Lean thinking directly improves a company’s financial bottom line, activities seem to have been
spurred on – and often supported - by some form of external influence, notably a series of government or trade association-backed voluntary initiatives. Among potential barriers to the wider dissemination of Lean thinking – especially where the aim is to address environmental impacts – perhaps the most important is the widely-held attitude that waste reduction is not a priority issue. Far more important for those involved in the food supply chain are the twin imperatives of managing food hygiene risks and ensuring product availability on shelves. However, as at least one study has shown, a trade-off need not exist between wasted product and on-shelf availability (23 p. 15). Among enablers or ‘success factors’, the limited evidence available indicates that engaging both employees and suppliers is crucial in Lean projects.

6.2 Opportunities

The UK food and drink retail sector is dominated by a handful of large multiple retailers exerting ‘an immense and sophisticated influence over the entire food supply chain’ (30 p. ii). Assuming the retailers can be effectively engaged, this could be seen as a tremendous opportunity to promulgate Lean thinking throughout the food industry. However, getting retailers to take the opportunity seriously may not be straightforward. Much of the costs of avoidable waste in the supply chain are faced not by retailers but by their suppliers, especially manufacturers. Given this, it is possible that the retailers may view using Lean thinking to tackle waste as a low priority.

As mentioned above, basic Lean approaches such as continuous improvement, measurement and target-setting are increasingly evidenced in the retail, wholesale and distribution sub-sectors; however, scope exists to step up such activities. Not only are they simple to perform regardless of a company’s financial resources, they offer huge potential to improve resource efficiency. An opportunity to extend the use of appropriate KPIs should also be noted; this is perhaps more suitable for larger players.

Moves towards better supply chain ‘visibility’ (something that is commonplace in mature Lean industries such as automotive) may offer tremendous opportunities. Some of the problems addressed by better supply chain visibility – in theory at least – include (31 p. 1220):

- Better coordination of physical movements within the supply chain
- Better coordination of decision making
- Better price coordination
- Optimal inventory holding polices
- Improved responsiveness
- Improved planning and replenishment capabilities
- Improved decision making
- Improved quality of products

The aim is to improve the retailers’ ‘own internal decision making and operating performance’ (31 p. 1217), although this assumes that the information shared ‘is accurate, trusted, timely, useful, and in a readily usable format’ (31 p. 1218). Importantly, greater visibility would help tackle the adverse impact of promotions and problems caused by demand amplification.

In fact, evidence already suggests a trend in the retail supply chain – enabled by advances in technology (especially the RFID technology mentioned in Section 1) – towards the sharing of information such as point of sale data (POS), inventory levels and forecasts, in order to gain increased visibility of customer or supplier operations and activities. For instance, WRAP’s 2011 Fruit and Vegetable Resource Maps reports that some ‘retailers are open to sharing information with their suppliers and in some cases they can even have employees from the supplier (embedded) working on site, so that they can be in close communication. These kinds of practices have proved to be effective in reducing forecasting error and hence waste; however, they can also be expensive since they demand considerable resources from both suppliers and retailers’ (7 p. 79). Similarly, as discussed in Section 4.4, a major UK retailer interviewed for
this project is now moving towards greater supply chain visibility in order to tackle the problem of demand amplification (DP001). A further example comes from a 2009 survey on sustainability in supply chains which reports that the food manufacturer ConAgra Foods partners with several retail customers ‘including Walmart, to share data monthly and ensure both sides are aware of what the other is doing’ (17 p. 36).

6.3 Gaps

As mentioned above, published evidence on the use of Lean thinking in all the sub-sectors in question was generally scarce. However, a notable evidence gap was found for wholesale. This sub-sector would benefit from further research in Phase 2.

Another promising area of future research might examine the possible contradiction, raised in Section 4.6, between practices appearing Lean on the spreadsheet for some measures (e.g. speed of response or de-stocking) but resulting in decidedly inefficient uses of other resources (e.g. poor use of road haulage capacity). The 2009 update to the Dairy Roadmap, reports significant savings in emissions from transport improvements, ‘with retailers making improvements to the transport efficiency with fewer vehicles moving more goods. Retailers have also invested heavily in alternative transport, including the introduction of double decked lorries, and the use of both trains and water-based transport systems’ (32 p. 17). Similarly, the retailer Marks & Spencer claimed in 2010 to have reduced fuel use by 30% per product (general merchandise rather than food), ‘mainly due to a move to loose loading which allows us to get more products into a delivery vehicle’ (14 p. 21). It would be interesting to find out the extent to which Lean thinking has – or could be – used to deliver these solutions – although problem-solving through capital expenditure would be out of scope.

Linked to this is the fundamental topic of demand forecasting; Phase 2 could focus on how Lean thinking may be employed to improve this. The authors of WRAP’s 2011 Fruit and Vegetable Resource Maps report that a variety of practices are used for the ‘accurate forecasting of customer demand through monthly and weekly plans’; but which approach or methods are most successful is currently unknown (7 p. 4).

Further work may also be required on the importance of corporate attitudes towards the implementation of Lean practice. As has already been mentioned, Lean can sometimes have a negative connotation particularly when viewed by staff as a ‘top down’ imposition.

Future research might also explore the question of KPI selection. Knowing a problem has been improved is impossible unless it can first be measured, but collecting too much data may be self-defeating. It has to be the right measures, at the right time. The Food Chain Centre, which has undertaken much of the ‘true Lean’ work published in the literature points to the importance of choosing a few vital measures: ‘With performance measures, there’s a tendency to keep adding more until you create an avalanche of figures. Critical information is then swamped by irrelevant data’ (4 p. 37). Similarly, the authors of a 2003 paper on sustainability in food production systems point out that the ‘enormous number of indicators found in the literature generates too much data that often provide no additional knowledge on the environmental sustainability of a system’ (33 p. 231).
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