INVESTIGATING SUPPLIERS AND SUPPLY SUB-CHAiNS IN ORDER TO REDUCE PACKAGING WASTE: A CASE STUDY OF THE NORFOLK AND NORWICH UNIVERSITY HOSPITAL

By

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Thesis presented in part-fulfilment of the degree of Master of Science in accordance with the regulations of the University of East Anglia

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ABSTRACT

Examples in the literature review show that environmental purchasing practices can contribute to reduction of waste. The Norfolk and Norwich University Hospital (NNUH) was used as a case study to investigate how effective environmental purchasing practices can lead to minimizing packaging waste in the catering sector.

A four day waste audit was conducted to obtain quantitative data and identify the different types of generated waste. The baseline data from the waste audit show that best available waste management practices are followed only in one out of seven waste streams that can be diverted from landfill and 74.50kg (42% of all packaging waste) of recyclable packaging waste is currently disposed off to landfill every day.

Internal interviews were conducted with key staff employees in the procurement and waste management sector to review current practices and examine the potential for improvement.

Additionally, interviews with 13 suppliers of the NNUH catering sector were conducted, using a designed questionnaire, to evaluate their environmental as well as their perception of packaging and current practices. In this way, an assessment of their involvement in the issue of packaging waste can be made. The results show that suppliers are aware of the main impacts of packaging and that they will need to improve their environmental performance.

A number of barriers to enhance environmental purchasing and effective waste management were identified and appropriate recommendations were made to overcome these.

The primary conclusions of this dissertation are that there are opportunities to divert packaging waste from landfill and that environmental purchasing, effective waste management practices and environmental conscious suppliers have all a significant role to play in achieving that goal.
ACKNOWLEDGEMENTS

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1. INTRODUCTION

1.1 Introduction

Today, developed and rapidly developing economies are constantly increasing the pressure on the environment. Finding ways to reduce the negative impacts of our production and consumption patterns on our environment, health and natural resources is a top priority (Mogens, 2005).

Just like any other major economic sector, the health care system is thus a major consumer of a wide variety of both renewable and non-renewable resources. It seems ironic that the health care system, which is a potent symbol of health in the community, is at the same time a source of local and global environmental harm, causing adverse effects on human health. The contribution of the health care system to environmental damage, through its use of resources and production of wastes, seems to have received little attention. It is no exaggeration to state that the health care system has an overriding ethical duty to take steps to reduce its environmental and human health impact. Other reasons are that it helps avoiding exposure to liability and regulatory penalties and reduces costs, freeing up money for patient care (The Canadian Coalition for Green Health Care, 2001).

This project investigates suppliers and supply sub-chains of the Norfolk and Norwich University Hospital’s (NNUH) catering sector, as well as current waste management methods implemented by NNUH, with a view to minimizing packaging waste.

1.2 NHS TRUST and Waste Production

The overall aim of the Department of Health is to improve the health and well-being of people in England. Protecting the environment is an imperative need and governmental policy is that environmental considerations should be properly taken into account in the activities and services of the NHS (NHS Estates, 2005).
The NHS is now the largest single organization in Europe and one of the largest employers in the world, employing more than one million people. It purchases good and services totaling in excess of £11 billion each year. As a result, the environmental impacts of its operations are extensive.

The domestic waste generated by the NHS in England and Wales includes (EA, 2004):

- General waste from wards (newspapers, magazines, paper towels, etc.);
- Waste from office areas, public toilets and corridors;
- Kitchen waste.

Only 1.8% of the domestic waste produced by the NHS was recycled, resulting to £14.5 million per year profit that could have been made if waste was effectively segregated. The profit could have been even higher if waste minimization procedures were in place.

Table 1.1 illustrates the domestic waste generated by the NHS in England and Wales by product type in 2003 and clearly shows that landfilling is the predominant method of waste management (98% of total domestic waste was landfilled), although almost every component has the potential to be reused or recycled.
Table 1.1: Domestic waste generated by the NHS in England and Wales by product type in 2003

<table>
<thead>
<tr>
<th>Product</th>
<th>Total Domestic Waste (tonnes)</th>
<th>Landfill/Incineration (tonnes)</th>
<th>Recycled (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Waste</td>
<td>261,086</td>
<td>256,338</td>
<td>4,748</td>
</tr>
<tr>
<td>Cardboard</td>
<td>33,941</td>
<td>33,199</td>
<td>743</td>
</tr>
<tr>
<td>Office Paper</td>
<td>31,330</td>
<td>30,739</td>
<td>592</td>
</tr>
<tr>
<td>Other *</td>
<td>26,109</td>
<td>25,931</td>
<td>178</td>
</tr>
<tr>
<td>Kitchen Waste</td>
<td>24,803</td>
<td>24,609</td>
<td>194</td>
</tr>
<tr>
<td>Plastics</td>
<td>24,150</td>
<td>23,901</td>
<td>250</td>
</tr>
<tr>
<td>Newspapers and Magazines</td>
<td>22,192</td>
<td>22,019</td>
<td>173</td>
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<tr>
<td>Glass</td>
<td>20,887</td>
<td>20,622</td>
<td>265</td>
</tr>
<tr>
<td>Aluminum</td>
<td>16,971</td>
<td>16,594</td>
<td>376</td>
</tr>
<tr>
<td>Textiles</td>
<td>16,971</td>
<td>16,649</td>
<td>321</td>
</tr>
<tr>
<td>Other Metals</td>
<td>15,665</td>
<td>15,107</td>
<td>558</td>
</tr>
<tr>
<td>Electrical Equipment</td>
<td>14,360</td>
<td>14,099</td>
<td>261</td>
</tr>
<tr>
<td>Toner Cartridges</td>
<td>13,707</td>
<td>12,870</td>
<td>837</td>
</tr>
</tbody>
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Other* = Undefined Waste

Source: NHS PASA, (2003d)
2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Definition of Waste

The definition of waste can be very subjective because what represents waste to one person may represent a valuable resource to another. Waste must have a strict legal definition to comply with the law (Williams, 2005). The starting point for all waste definitions is the definition given in the Waste Framework Directive (75/442/EEC) (Holgate, 2000 p55; IPPR and Green Alliance, 2006 p9) ‘Waste is any substance or object in the categories set out in Annex I (Appendix I), which the holder discards or intends or is required to discard’.

According to Williams (2005) waste can be classified by physical state (solid, liquid, gaseous). Solid waste can be classified by original use (packaging waste, food waste, etc.), by material (plastic, paper, glass, etc.), by physical properties (recyclable, compostable, etc.), by origin (household, commercial and by safety level (hazardous, non-hazardous).

Waste is an inevitable product of society and one of the most important issues on the political agenda. The natural environment now acts as the source for resources and the sink for wastes (Glasson et al., 1999).

In recent years waste has been recognized as a major environmental problem and legislative measurements have been put in place to improve the sustainable management of waste (Dawson and Probert, 2007).

2.2 Packaging and Packaging Waste

The most common definition of packaging is ‘all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods and products, from raw materials to processed food, from the producer to the user or consumer’ (IEMA, 2003 p6; DEFRA(Annex C8), 2007 p1; DTI, 2007 p7; SEPA, 2007 p64)
Packaging is a relatively small but not insignificant product and waste stream, which is around 5% of total waste generation (Commission of the European Communities, 2006).

Packaging is categorized into three primary types (Livingstone and Sparks, 1994; Davis and Song, 2006):

- Sales packaging or primary packaging, which is normally in contact with the goods and taken home by consumers;
- Grouped packaging or secondary packaging, which covers the larger packaging used to carry quantities of primary packaged goods;
- Transport packaging or tertiary packaging, which refers to the packaging that is used to assist large quantities of goods (not including road, rail, ship and air containers).

Packaging waste is a major component of the commercial waste stream. It includes paper or pulp-based materials, plastics, glass, metals, wooden pallets and aluminum and steel food and drink cans (Davis and Song, 2006). The best practicable environmental option for packaging is minimization and reuse, followed by recovery by recycling or energy recovery (Department of the Environment and Welsh Office, 1995).

Packaging is a major application area for plastics (Mutha et al., 2006). It accounts for 36% of plastics consumption (Remade, 2006). The American Society of Plastics Industry marking code is widely used for labeling six main types of plastic. Table 2.1 points out typical applications of the main plastics types in Europe and in Appendix II the codes for different plastics are presented. Figure 1.1 illustrates the percentage of the use of plastics in packaging in the UK.
Figure 1.1: Percentage of packaged goods

Table 2.1: Primary applications of plastics

<table>
<thead>
<tr>
<th>Plastic Type</th>
<th>Typical Application</th>
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<tbody>
<tr>
<td><strong>Thermoplastics</strong></td>
<td></td>
</tr>
<tr>
<td>High density polyethylene (HDPE)</td>
<td>Household chemical bottles, bottle caps, toys, house wares</td>
</tr>
<tr>
<td>Low density polyethylene (LDPE)</td>
<td>Bags, sacks, squeeze bottles, bin liners, cling film, containers</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC)</td>
<td>Food trays, bottles, toys, cable insulation, cling film, wallpaper, flooring</td>
</tr>
<tr>
<td>Polystyrene (PS)</td>
<td>Egg cartons, yogurt pots, vending cups, cutlery, meat and fish trays</td>
</tr>
<tr>
<td>Polyethylene terephthalate (PET)</td>
<td>Drink bottles, food packaging, oven-ready meal trays</td>
</tr>
<tr>
<td>Polypropylene (PP)</td>
<td>Packaging film, tubs, crisp packets, trays</td>
</tr>
</tbody>
</table>

Source: Waste Online (2001)

Almost all consumer goods purchased in every day life come with packaging which fulfills at least one of the following functions (Davis and Song, 2006):

- To provide protection from physical damage, contamination and deterioration;
- To give sales appeal;
- To ensure the product identity is easily recognizable;
- To give information about the product;
- To optimize distribution and storage costs;
- To provide consumer convenience and safety.
The main reason to use packaging is to prevent product wastage. It enables products to be brought from factories to consumers (INCPEN, 2006).

The packaging chain generally consists of four main stages (DEFRA, The Scottish Executive and The National Assembly for Wales, 2003). Those who:

- Manufacture raw materials for packaging;
- Convert raw materials into packaging;
- Pack and fill packaging, or use packaging to wrap goods;
- Sell packaging to the final user.

According to INCPEN (2006), the UK uses less packaging per person (171kg per capita in 2004) than many other EU countries, such as Germany (188kg per capita), Netherlands (198 kg per capita) and France (200 kg per capita), but still, it is at the top end. Packaging in the UK contributes 18% of household waste, which represents about 3%, by weight and volume, of landfilled waste. GDP per capita is directly related to packaging consumption per capita for different countries (Mutha et al., 2006). Packaging waste arisings and projections for the UK is shown in Appendix III.

The packaging industry has been under pressure internationally for more than 20 years to reduce the environmental impacts of its products (Lewis, 2005). Retailers need to do more to reduce packaging, building on existing progress (DEFRA, 2007). Since the introduction of the packaging Regulations and their recovery and recycling targets, there has been a significant increase in the level of packaging waste recovery, about 20% since 1999. In 2006 the recycling rate of packaging waste stood at 56%, with overall recovery at 61% indicating that the UK is on track to meet the 2008 target of 60% (EHS, 2007). The estimate of UK packaging flow by 2008 is 10.75 million tones (VALPAK, 2005).

In order to address the problem of excessive packaging, thirteen major retailers and brands, representing 92% of the UK grocery market have set packaging reduction targets by designing out packaging waste growth and identifying ways to tackle the problem of food waste in the near future (WRAP, 2006; DEFRA, 2007). Some
examples of waste minimization by producers and retailers are presented in Appendix IV.

2.3 Waste Policies and Strategies

The European Union (EU) has developed Directives, Regulations and Decisions of the legislature which apply to various waste sectors, waste streams, waste treatment and disposal processes. The EU Waste Framework Directive which was introduced in 1975 and was subsequently amended several times, established the general rules of waste management (Williams, 2005).

According to GEE (2000), the EU recognizes five principles for waste management:

- Waste Management Hierarchy: It is at the centre of the European waste management policy. Above all waste strategies must aim to prevent the generation of waste and reduce the harm it causes. If this is not possible, waste should be reused, recovered or as a last preferable option, disposed (figure 2.1);
- Producer Responsibility: The manufacturers of products have an increased share of the responsibility for dealing with waste that arises from their products;
- Self-Sufficiency: It should be a feature of all waste disposal facilities in regional, sub-regional and national level;
- Proximity: Waste should be disposed of or managed, close to the point of which it is generated;
- Best Available Technique Not Entailing Excessive Costs (BATNEEC): technology employed should prevent pollution and be reasonable to implement in financial terms.

The EU Directive on the Landfill of Waste (1999/31/EC) introduced major changes into the management of waste in the UK and the rest of Europe with one of the main targets being waste minimization and reduction of materials disposed to
landfill (Williams, 2005). It aims at reducing the amount of biodegradable and other types of waste disposed in landfills, which is the predominant disposal route for waste in the UK (Brady, 2005). By introducing strict operational and technical requirements for waste and landfills the adverse effects on the environment from the landfilling of waste can be minimized (Williams, 2005). The following reduction targets for waste going to landfill have been set:

- 75% of the total biodegradable waste produced in 1995, by 2006;
- 50% by 2009;
- 35% by 2016;

2.4 Legislation that applies to Packaging Waste streams

Packaging was identified as a priority waste stream in the European Commission’s Fifth Environmental action Program because of the amount of waste arisings, the trend for these to continue to rise and concern about the impact of these waste streams on the environment (DEFRA, 2007).

The EU Directive on Packaging and Packaging Waste 94/62/EC (the Directive) was agreed on 20 December 1994. According to it, obligated businesses are required to recover, reuse and recycle specific amounts of packaging waste, incorporating the targets set. The EU members are able to decide how they want to realize the objectives of the Directive (Chappin et al., 2005). It is essential to minimize the amount of packaging used by using fewer resources and thus creating less waste (Livingstone and Sparks, 1994). The Directive was designed to encourage more sustainable use of packaging, the aim being to encourage practices which minimized packaging and increased recycling and reuse and consequently reducing the amount of packaging waste being disposed of to landfill (IEMA, 2003). It creates a more stable economic framework for separate collection of packaging waste and its recycling and recovery (Commission of the European Communities, 2006). The provisions of this Directive are implemented in the UK in the UK through two sets of Regulations (DEFRA, 2007):
• The Producer Responsibility Obligations (Packaging Waste) Regulations 1997 (amended in 2007) (the ‘packaging Regulations’); and
• The Packaging (Essential Requirements) Regulations 1998 (amended in 2006), (the ‘Essential Requirements Regulations’).

The Packaging (Essential Requirements) Regulations entered into force on the 31 May 1998 and implemented the single market provisions of the EC Directive on Packaging and Packaging Waste (94/62/EC) (IEMA, 2003; DTI, 2007). The Regulations were amended by the Packaging Regulations 2004 and the Packaging Regulations 2006. The Regulations apply to all packaging that is placed on the market in the UK, as packed or filled packaging. The essential requirements for packaging as stated in are:

• Packaging must be minimized subject to safety, hygiene and acceptance for the packed product and for the consumer;
• Noxious or hazardous substances in packaging must be minimized in emissions, ash or leachate from incineration or landfill;
• Packaging must be produces as being capable of recovery through: material recycling, incineration with energy recovery and composting or biodegradation;
• Packaging may be reusable;

The packaging Regulations set annual business targets for recovery and recycling of packaging waste designed to allow the UK to meet the recovery and recycling targets in the Directive, including the material-specific recycling targets. The Directive targets that the UK has to meet by 31 December 2008 are (DEFRA, 2007; SEPA, 2007):

• 60% recovery of packaging waste;
• 55% recycling of packaging waste;
• 60% recycling of glass packaging waste;
• 60% recycling of paper/board packaging waste;
• 50% recycling of metals packaging waste;
• 22.5% recycling of plastics packaging waste; and
• 15% recycling of wood packaging waste;

When the Producer Responsibility Obligations (Packaging Waste) Regulations became law on 6 March 1997, a new regime of responsibilities for the waste created from the packaging surrounding products was introduced. Obligations were placed on businesses involved in the supply chain and use of packaging (IEMA, 2003). The aim was to help improve the efficiency with which resources are used, achieve a more sustainable approach to dealing with packaging and packaging waste and to reduce the environmental impacts of products across their life cycle (DEFRA, The Scottish Executive and The National Assembly for Wales, 2003). As Brady (2005) underpins, it meant to ensure the productive use of products and materials that have served their environmental purpose.

The underlying purpose of all producer responsibility legislation is waste minimization and reduction of materials disposed to landfill (Hage, 2007). Producer responsibility legislation should therefore be considered as an integral part of the country’s waste management strategy (IEMA, 2001). Packaging has been the pioneer on producer responsibility (IEMA 2003).

2.5 The Waste Hierarchy

Each year the UK generates about 100 million tones of waste from households, commerce and industry. Most of this ends up in landfill, where the biodegradable part generates methane (a potent greenhouse gas) while valuable energy is used in extracting and processing new raw materials (DEFRA, 2007). The aim should be to reduce waste by making products with fewer natural resources and break the link between economic growth and waste growth. Most products should be reused, or their materials recycled. Energy should be recovered from other wastes where possible. For a small amount of residual materials landfill will be necessary. (DEFRA, 2007).

The key aim of the current waste management strategy for England and Wales is to achieve fully sustainable waste management and is based upon a concept of a hierarchy (Figure 2.1) of preferable options for the treatment and disposal of waste.
Where waste is produced it means dealing with it in a way which minimizes impacts on the environment and contributes positively to economic and social development (Williams, 2005).

![Waste Hierarchy Diagram](image)

**Figure 2.1:** The Waste Hierarchy (DEFRA, 2007)

Waste prevention is the most preferable option. When this option is not available or feasible the next best option is the reduction of waste at source through clean technologies and processes that require less material in the end product and produce less waste in their manufacture (Williams, 2005). When further reduction is not possible, products and materials can be reused for the same or different purpose (DEFRA, 2007). Recycling recovers materials from waste and converts them into a marketable product. Composting is the process of breaking down organic waste with the use of micro-organisms, usually to produce compost suitable for adding to soil (Williams, 2005). Energy is recovered from waste through methods such as incineration with energy recovery. The disposal of waste to landfill is the least suitable practice for waste management and is placed at the bottom of the waste hierarchy (Williams, 2005).

Effective waste management practices, as illustrated in the Waste Hierarchy, aim to enhance environmental performance through all stages of the supply chain and thus are related to issues like (Green) Supply Chain Management and Environmental Purchasing which will be analyzed next.
2.6 Supply Chain Management and Green Supply Chain Management

Interest in Environmental Supply Chains is based upon increased awareness in environmental issues, the increasingly strategic importance of purchasing and trends towards cooperation and partnership approaches between customers and suppliers (Green et al., 1996). There is a growing need for integrating environmentally sound choices into Supply Chain Management research and practice (Srivastava, 2007).

Various definitions exist regarding Supply Chain Management (SCM). Lambert et al. (1998 p1) define SCM as ‘the integration of key business processes from end user through original suppliers that provides products, services and information that add value for customers and other stakeholders’. Hervani et al., (2005 p331) argue that SCM is ‘the coordination and management of a complex network of activities involved in delivering a finished product to the end-user or customer’. SCM offers clear views of opportunities and threats of the supply chain and helps informing strategy formation (Billington, 1999). SCM usually takes into consideration issues of end cost (market cost), efficient logistical aspects and timely delivery of goods (Khoo et al., 2001). Hall (2000) argues that a holistic approach to SCM can benefit environmental management practices.

The definition of Green Supply Chain Management (GSCM) is not clear because the combination of corporate environmental management and supply chain management is a relatively new area of study and practice (Zhu and Sarkis, 2006). Godfrey (1998 p244) identifies GSCM as ‘The practice of monitoring and improving environmental performance in the supply chain’. Srivastava (2007 p54) defines GSCM as ‘integrating environmental thinking into SCM, including product design, material sourcing and selection, manufacturing processes, delivering of the final product to the customers as well as end-of-life management of the product after its useful life’ and argues that GSCM ranges from reactive monitoring of the general environment management programs, to proactive practices implemented through various Rs (Reduce, Re-use, Rework, Refurbish, Reclaim, Recycle, Remanufacture, Reverse logistics, etc.). GSCM is shown graphically in Appendix V. GSCM has emerged as a key approach for enterprises seeking to become environmentally sustainable (Zhu et al., 2005).
GSCM practices, according to Zhu and Sarkis (2006), range from green purchasing to integrated supply chain flowing from suppliers, to manufactures, to customers and reverse logistics. They state five GSCM practices that can be used to improve performance:

- Internal environmental management;
- Green purchasing;
- Cooperation with customers;
- Investment recovery;
- Eco-design.

Diffusing environmental management techniques along the supply chain can be an appropriate method of enhancing the environmental performance of an industry (Lamming and Hampson, 1996; Hage, 2007).

Green purchasing and eco-design focus on the early stages of a product’s supply chain (Zhu and Sarkis, 2006).

Srivastava (2007) concludes that GSCM can reduce the ecological impact of industrial activity without sacrificing quality, cost, reliability, performance or energy utilization efficiency.

‘Green purchasing’ or else ‘environmental purchasing’ is an integral activity of the GSCM and is analyzed below.

2.7 Environmental Purchasing

Effective environmental purchasing is a key element for the operation of an organization with a view towards sustainability (IEMA, 2002). It mainly focuses on product design and process improvement (Chen, 2005). Min and Galle (2001 p1222) identify green purchasing as ‘an environmentally conscious purchasing practice that reduces sources of waste and promotes recycling and reclamation of purchased materials without adversely affecting performance requirements of such materials’.
Consequently, by implementing green purchasing practices at design phase and through final disposal of the product, an organization can minimize packaging waste and make more sustainable purchases of products.

The practice of environmental purchasing has been a much neglected subject in the past, when purchasing was the poor relation in environmental activity but more recently significant progress has been made and purchasing with the environment in mind is now on the agenda for a wide range of companies (Brady, 2005; Bergeson, 2002). Walton et al. (1998) stress that companies today cannot ignore environmental issues. Increasing government regulations and stronger public mandates for environmental accountability have brought these issues into the executive suite and onto strategic planning agendas. At the same time companies are integrating their supply chain processes to lower costs and better serve customers and must involve suppliers and purchasers to meet and exceed the environmental expectations of their customers and their governments. In the US several large health systems have developed green purchasing policies (The Canadian Coalition for Green Health Care, 2001).

Carter and Carter (1998 p 659), define Environmental Purchasing (EP) exactly the same as Zsidsisin and Siferd (2001 p68) define Environmental Supply Chain Management (ESCM) which is ‘the purchasing function’s involvement in activities that include reduction recycling, reuse and the substitution of materials’. ESCM for an organization is the set of supply management policies held, actions taken and relationships formed in response to concerns related to the natural environment with regard to the design, acquisition, production, distribution, use, reuse and disposal of the organization’s goods and services. Environmental purchasing is a subset of environmental supply chain management (Zsidsisin and Siferd, 2001).

Today, purchasing and environmental professionals and others recognize the strategic importance of the supply chain in the transition to a more sustainable world (IEMA, 2002). Purchasing is at the beginning of the value chain and it placed in an advantageous position to implement resource reduction activities (Ellram and Pearson, 1993; Dowlatshahi, 1992; Stuart. 1991). Purchasing managers are now in a better position than ever to modify procurement specifications and substitute more
environmentally friendly materials (Carter and Carter, 1998). The goods and services procured and the actions or lack of actions by purchasing professionals have a direct impact on the natural environment. The purchasing function is in a critical position to influence an organization’s response to concerns about the natural environment (Zsidisin and Siferd, 2001).

It is an increasingly important issue and decision-making tool for every enterprise that improves overall competitiveness and the enterprise’s strategic position in the market (Mebratu, 2001). Green purchasing is an effective tool to mitigate the environmental impacts of consumption and promote the development of clean production technology focusing mainly on product design and process improvement and eventually brings about competitive advantages in the international market (Hart, 1997). Purchasing, in many organizations, represents in excess of 60% of all expenditure (Green et al., 1996; Chen 2005). It does not only focus on the cost of work, but also on the value of work depending on both environmental and financial considerations. Therefore, there is a need to be proactive, addressing environmental issues within the organization, as well within the supply chain (Walton et al., 1998). The traditional role of purchasing must be reevaluated in the light of the drive towards better environmental management throughout organizations and throughout supply chains. Chen (2005) underlines that environmental purchasing should be split into two stages:

1. The qualification screening of suppliers, products and logistics systems;
2. The general green purchase practices (Table 2.2)

The first stage is seen as the minimum requirements of the purchase specification to guarantee environmental performance and includes three parts: vendor selection, eco-labeling of parts and environmental impacts of logistics systems. The second stage is formed as the procedural parts of the specification in order to guarantee the financial performance (Chen, 2005) and is illustrated below.
Table 2.2: General purchase practices

<table>
<thead>
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<th>2nd stage: General purchase practices</th>
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<tr>
<td>Final decision rules</td>
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</tbody>
</table>

Source: Chen (2005)

According to IEMA (2002) good and effective practices for environmental purchasing tend to be:

- Integrated with an organization’s overall business objectives and procurement strategies.
- Backed by senior level commitment.
- Well communicated throughout the organization.
- Supported by clear objectives and targets.
- Owned by those responsible for delivering them.

DEFRA (2003) also provides some key points for successful consideration of the environment in purchasing:

- Consider the environment from the outset;
- Carefully plan the whole purchasing process;
- Initiate early dialogue with the supplier community;
- Develop an environmental purchasing strategy;
• Secure commitment to your environmental purchasing strategy at a senior level

It is essential for an organization to have a clearly identified policy towards green purchasing which should describe the objectives and targets of green purchasing. Top management needs to refine and review the environmental objectives and policies of green purchasing to assure effective planning and implementation (Chen, 2005). Furthermore, support from mid-level managers is also key to successful implementation of environmentally friendly practices (Carter et al., 1998).

Communication is a key factor and must occur within the company, with suppliers, customers, industry and government officials and coordination between buyers and suppliers will further environmental purchasing activities (Zsidisin and Siferd, 2001). Better information is needed at all levels to widen and deepen the scope for green purchasing (Thomson and Jackson, 2007).

The management needs to assign environmental responsibilities to all levels of the company as well as purchasing personnel with a specified target and with a clear documentation process. The purchase procedures must be developed and resources are needed to allocate and implement the tasks of green purchasing (Chen, 2005).

The most common arguments against green purchasing are that it is more expensive than conventional procurement, as well as problematic from a legal point of view (Min and Galle, 1997). Mogens (2005) states that both are incorrect and carries on by saying that many green alternatives today are no more expensive than alternative products and even if some are, in terms of their initial purchase price, they save money during their life-cycle which offsets their initial cost, offering long-term savings. The life-cycle cost of a product includes the purchase price, the cost of use and the cost of disposal (Figure 2.2). The initial cost and short term orientation, however, is the reason why the degree of involvement in green purchasing is positively related to the size of a buying firm (Min and Galle, 2001; Hervani et al., 2005). Another obstacle is the lack of environmental knowledge of purchasing managers and their perception that recycling is uneconomical. In general, empirical studies demonstrate a positive relation between environmental knowledge and
environmentally positive behavior (Chan, 2001). Buying firms tend to perceive their environmental program as a cost center rather than a profit center (Min and Galle, 2001), but in reality results indicate that purchasing managers can contribute to the environmental endeavors of their firms while enhancing firm performance (Carter et al., 2000). Training and retraining were found to be important factors for environmental purchasing (Zsidisin and Siferd, 2001).

Another difficulty associated with formulating a green purchasing strategy is that it may reduce the pool of qualified suppliers due to stricter environmental quality standards (Min and Galle, 2001). Dawson and Probert (2007) argue that another issue is the perception that green products are of poor quality, which is no longer the case with green products today.

One possible solution to address these problems is to develop a systematic means of translating environmental failures into tangible money figures and help top management assess the real economic advantage of green purchasing (Min and Galle, 2001).

Figure 2.2: Life Cycle (DEFRA, 2007)
2.8 The Role of Suppliers

A key procurement decision is the selection of suppliers, as it is often the suppliers that will directly manage the key sustainability impacts either through their own business activities or through their own suppliers along the supply chain (Brady, 2005). Purchasing connects a firm with the suppliers who provide the necessary goods and services for the purchasing firm’s production or service processes (Zsidisin and Siferd, 2001).

Suppliers may come under considerable pressure from customers to improve their environmental performance (IEMA, 2002; Chen, 2005; Azzone and Bertele, 1994). In the case of packaging waste, suppliers would have to apply effective waste management methods and minimize packaging waste. Customers are becoming increasingly environmental conscious and demand environment-friendly products (Enarsson, 1998). When suppliers, contractors and other partners are involved, purchasing and supply chain managers have a critical part to play in driving environmental improvements forwards and therefore all those who are involved in purchasing decisions need to be aware of, and involved in, environmental purchasing (IEMA, 2002). The key is to motivate suppliers offer more sustainable products (WRAP, 2003).

However, Cramer (2000) in his study found that customers rarely put direct pressure on suppliers to improve the environmental performance of their products. Therefore, an evaluation of suppliers can influence them to improve their manufacturing practices and environmental performance by adopting the use of packaging materials appropriate to the customer’s needs (Zsidisin and Siferd, 2001). Suppliers can be evaluated through the use of rating systems that use qualitative as well as quantitative factors in determining environmental performance (Noci, 1997). Purchasers with significant buying power in particular markets can encourage suppliers, through volume purchasing, to invest in new technologies and develop new products with higher environmental specifications and bring forward innovative solutions to environmental problems, thus strategically influence the supply chain’s attitudes and actions in a way that will be environmentally responsible (Walton et al., 1998; Min and Galle, 2001).
IEMA (2002), states that they can stimulate markets for:

- Recycled products or those with a high recycled material content.
- New services delivering an equivalent function to the products they replace but at lower environmental cost.

Understanding the market and a supplier’s skills is a core role of procurement (EA, 2002). Companies have begun to integrate environmental criteria into their purchasing policies and procedures (Green et al., 1996). Most companies use a set of criteria to ensure that suppliers meet their standards. ‘Pre-qualification’ involves a company vetting potential suppliers of goods and services to identify those able to meet the required standard. Traditionally price and quality characteristics have formed the basis for appraisal of suppliers and their products but many organizations now include environmental factors in their pre-qualification criteria (Enarsson, 1998; Humphreys et al., 2003). The commercial threat of losing significant business drives suppliers to meet these environmental standards to maintain a competitive edge in the marketplace (Humphreys et al., 1993). This is one simple approach to integrating environmental considerations into day-to-day purchasing operations (IEMA, 2002).

Supplier appraisal is a procedure routinely used by purchasing professionals. Purchasers need to take a range of factors into account when deciding on which products to purchase. Environmental impacts are just one of them and usually cost is top of the list, but they must not confuse lowest price for the lowest cost (IEMA, 2002). Environmentally preferred purchases are often more cost-effective in the long term (Mebratu, 2001) and purchasing professionals must look at the entire life cycle of products and their subsequent impact on the environment (Carter and Carter, 1998). Purchasing must be proactive if it is to address these issues and include supplier selection and evaluation, supplier development and the integration of suppliers into environmental management initiatives (Walton et al., 1998). According to Min and Galle (2001), 78% of surveyed purchasing professionals viewed suppliers’ advantages in developing environmentally friendly goods as an important supplier selection factor.
Enarsson (1998) by adopting a quality improvement prospective identified four main factors for appraisal of suppliers. They are listed in table 2.3 including sub-sections under each one.

**Table 2.3:** Environmental factors and sub-sections for appraisal of suppliers

<table>
<thead>
<tr>
<th>Environmental factor</th>
<th>Sub-sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier as a company</td>
<td>Environmental system, management, other concerns (laws, research)</td>
</tr>
<tr>
<td>Suppliers process</td>
<td>Articles for our needs, articles for other companies</td>
</tr>
<tr>
<td>Product</td>
<td>Recycling, other concerns (packaging)</td>
</tr>
<tr>
<td>Transportation</td>
<td>Return loads, optimizing loads, choice of transportation</td>
</tr>
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</table>

Source: Enarsson (1998)

### 2.9 Environmental Concerns of Product Packaging

Products are a very crucial element in the network of production, consumption and disposal. Products are the carriers of material’s flow, energy usage, functional performance and environmental impacts, therefore have an important role for making progress in achieving sustainability (Li and Geiser, 2005). With the emergence of cleaner production and pollution prevention, the focus has been and will be further pushed upstream in the production and manufacturing process. Once a product is out on the market there is less potential to improve its environmental performance (DEFRA, 2003). More resources will be spent, less effectiveness will be achieved and the environmental degradation will not be reduced (Li and Geiser, 2005). Traditional ‘end of pipe’ solutions are giving way to innovative approaches to managing waste at source (Green et al., 1996). This is the exact objective of Extended Producer Responsibility (EPR), to encourage producers to prevent pollution and reduce resource and energy by taking responsibility of the product after the end of its useful life.
As Green \textit{et al.} (1996) point out, up to 80\% of the whole life cost of a product or service is committed in the design stage of the life cycle. The importance of design and specification is therefore recognized by many companies and their suppliers, as careful consideration allows many potential environmental impacts to be ‘designed out’. Waste is best eliminated or reduced by careful attention to details in the design stages for both products and processes (Zsidisin and Siferd, 2001). Procurement, as an operation that links production and use, is of strategic importance to gaining maximum benefit out of a product (Mebratu, 2001).

Three common purchasing approaches, mirroring the Waste Hierarchy (see Figure 2.1), for addressing environmental concerns (Carter and Carter, 1998; Carter \textit{et al.}, 1998) are:

- Resource reduction
- Product reuse
- Recycle

Resource reduction is defined by Carter and Ellram (1998 p86) as ‘the minimization of waste which results in more efficient forward and reverse distribution processes’. Resource reduction strategies for packaging require minimizing the amount of packaging used, thus using fewer resources and creating less waste (Livingstone and Sparks, 1994; Neumayer, 2000). Reuse is ‘the use of a product or component part in its same form for the same use without re-manufacturing’ (Zsidisin and Siferd, 2001 p62; Hage, 2007 p 319). Reuse systems for packaging can operate very successful for transport packaging (Commission of the European Communities, 2006). Recycling is ‘the process by which materials otherwise destined for disposal are collected, processed and remanufactured into new products’ (Zsidisin and Siferd, 2001 p62; Alcalde \textit{et al.}, 2005; SEPA, 2007 p64). A comparison between recycling and reusing is shown in Appendix VI. Min and Galle (1997) found that over 70\% of firms have frequently or somewhat frequently used recycling as a form of source reduction. However, recycling requires a significant amount of effort in its conversion to other products (Livingstone and Sparks, 1994). Prevention of packaging at source is far more complex than recycling. It does not only influence the entire life cycle of
packaging from raw material extraction to disposal, but also the life cycle of the packaged products (Commission of the European Communities, 2006). A fourth related term can be ‘Reverse Logistics’, which Carter and Ellram (1998 p86) describe as ‘reverse distribution that includes resource reduction’. The role of reverse distribution is crucial for effective reuse and recycling to occur and upstream movement channels are almost never as well developed as forward logistics channels (Pohlen and Farris, 1992). The need for environmentally responsible logistics systems and the importance of reverse logistics programs are also highlighted by Wu and Dunn (1995), Mollenkopf and Closs (2005), Srivastava and Srivastava (2005).

Product packaging provides an example which uses all of the three approaches, to reduce the negative effects to the environment (Zsidisin and Siferd, 2001). Packaging is often regarded as unnecessary cost or a necessary evil but performs a number of functions, such as containment, protection, preservation, apportionment, unitization, communication and presentation (Robertson, 1990). Recycling is an alternative used more frequently as a form of source reduction, but even though it reduces the amount of waste for disposal, a considerable effort is required in its conversion to other products (Min and Galle, 1997). There is scope for further improvement, taking into consideration the local recycling potentials and adjusting packaging materials having in mind a joint up strategy between supplier and buyer.

According to IEMA (2003), the packaging process is likely to place greater emphasis on design for minimization within individual organizations. This will consequently create a situation where there will be less packaging per unit of production compared to the amount of packaging used at present.

2.10 The Relation of Environmental Purchasing and Sustainable Development

The UK government has committed itself to sustainable development in all that it does. Sustainable development is defined as the ‘development that meets the need of the present without compromising the ability of future generations to meet their own needs’ (WCED, 1987). Society has become much more interested in sustainable development as evidence has mounted over climate change, as well as concerns over security of energy supplies, the health consequences of pollution and the social
impacts of globalization (Thomson and Jackson, 2007). The model of sustainability is shown below and sustainability conditions are met where decisions sit in the central zone where environmental, social and economic attributes are all addressed.

Figure 2.3: The three circles model of sustainability (adapted by Brady, 2005)

The greening of public procurement was seen as an initial step that would provide suppliers with a major incentive to reduce their environmental impacts and stimulate markets for sustainable products and services (Thomson and Jackson, 2007). The Government’s 2005 Sustainable Development Strategy set out the ambitious goal to make the UK a leader in the EU in sustainable procurement by 2009 and to reach this goal a systematic effort to mainstream sustainable procurement was required (DEFRA, 2006).

Environmental purchasing has a connection with sustainable development (WRAP, 2003). Purchasing activities influence the types and resources consumed (IEMA, 2002). Sustainable development according to DEFRA (2003) relates to four broad objectives, which are:

- Social progress which recognizes the needs of everyone.
- Effective protection of the environment
- Prudent use of natural resources
- Maintenance of high and stable levels of economic growth and employment.
Sustainable development would only be achieved if society in general and industry in particular, learned to produce more goods and services with less of the world’s resources and less pollution and waste (White et al., 1995).

Sustainable procurement can be defined as the process whereby organizations meet their own needs for goods, services and utilities in a way that achieves value for money in a whole life basis in terms of generating benefits not only to the organization, but also to the society and the economy, whilst minimizing damage in the environment (Figure 2.4) (DEFRA, 2006).

![Sustainable procurement](image)

**Figure 2.4:** Sustainable procurement and Sustainability (WRAP, 2003)

Sustainable packaging would have to be packaging that is only used when it is necessary and when it fulfills its function of product protection, identification etc., as part of a sustainable production and consumption system (Lewis, 2005).

Procurement activities can make a significant contribution to an organization’s sustainability policy goals by ensuring that suppliers and products bought can achieve optimum environmental and ethical performance (Brady, 2005; EA, 2002). Procurement has a significant contribution to make in promoting environmental and social awareness in the wider market place through its supply community (EA, 2002). Finding the right balance between the involved economic and environmental interests is one of the main tasks (Commission of the European Communities, 2006)
2.11 Benefits of Environmental Purchasing

Environmental purchasing as pointed out in IEMA (2002) can:

- Reduce waste and improve resource efficiency
- Secure the supply of goods and services
- Minimize business risks
- Provide cost savings
- Provide added value
- Enhance corporate image
- Create markets for new products and services

Effective purchasing processes can make a significant contribution to reducing waste in an organization. In this way it can keep pace with the EU Directives that focus on waste. The government’s Waste Hierarchy can be regarded as Purchasing Hierarchy with the opportunity to re-think the need at the top of the hierarchy (see Figure 2.5). Where the amount of waste generated is large and waste management costs are high, there is likely to be substantial scope to improve environmental performance by improving purchasing practice. Buying ‘green’ can save money through reduced operating costs, reduced use of resources and reduced waste generation (Mogens, 2005; Klassen and McLaughlin, 1996; IEMA, 2002). Carter et al., (2000) with their study, were able to strongly support the hypothesis that environmental purchasing is positively related to firm performance.

But procurement is more than just saving money, it is about saving the planet (EA, 2002). Environmental procurement can contribute to a more sustainable energy system, by promoting renewable energy sources and energy efficiency (Mogens, 2005). Environmental procurement can help in meeting regulations. Adopting this approach at an early stage can help any enterprise meet progressively stricter environmental regulations at a lower overall cost (Mebratu, 2001) as well as avoid negative publicity that results from liability litigation and fines (Min and Galle). Furthermore it can help meeting stakeholder pressure by customers, trading partners,
insurance institutions beyond legal environmental responsibilities and improves competitiveness (Humphreys et al., 2003).

The Canadian Coalition for Green Health Care (2001) lists several reasons to be a ‘Green Hospital’, among which are:

1. Health care has an ethical duty to do no harm to the environment or to human health;
2. Being a good environmental neighbor enhances your hospital’s image and reputation in the community;
3. Effective waste separation can free up money for health care in the future and reduce costs;

Figure 2.5: Waste Hierarchy = Procurement Hierarchy (DEFRA, 2006)
4. Recycling products can actually generate revenue;
5. Reducing greenhouse gas emissions can help to reduce global warming and its associated health effects;
6. Good waste separation can reduce the amount of materials going to incineration and thus can reduce dioxin emissions;
7. Being environmentally responsible now puts you ahead of the regulatory regime.

Green purchasing is a practice that is effectively greening the supply chain and is becoming a key component of SCM (Walton et al., 1998). Many firms now implement and develop ‘green’ strategies to preserve the environment, as well as enhance efficiency and effectiveness (Carter et al., 1998).

2.12 Benefits of Sustainable Waste Management

Recycling and recovery of packaging leads to positive environmental effects, including greenhouse gas savings and resource savings. Packaging recycling can be classified with a relatively high degree of certainty among most cost-efficient options to reduce CO2 emissions and other environmental impacts (Commission of the European Communities, 2006; WRAP, 2006). Where a company or an organization can achieve lower packaging cost and reduce the quantity of packaging, this will be a great benefit to the environment and will allow the company to be in compliance with the Packaging Regulations. Therefore, packaging chosen with criteria of how easy the materials can be reused or recycled will be one of the main priorities. As Gray and Guthrie (1990) highlight, packaging lightweighting can not only reduce the cost of packaging, but can reduce transportation costs by increasing the amount of product which can be shipped and reducing packaging weight. However this should not in any case compromise safety or hygiene factors for the products.

The benefits of managing waste sustainably can be summarized in the following three categories:

- Environmental: the reduction of the amounts of waste produced can reduce the negative impacts on the environment;
• Economic: the reduction of waste produced provides cost savings by reducing the cost of disposal and raw material purchase; and
• Social: public acceptance to options towards the upper end the waste hierarchy is further increased.

The Canadian Coalition for Green Health Care (2001) refers to the case of The Medical Center Hospital of Vermont. It prepares 3000 meals per day and every day it trucks 270-410 kg of kitchen waste (not food from anyone’s plates) to a compost site managed by a non-profit group dedicated to organic food production. The 80 tonnes of food wastes that the hospital sent to compost in 1993 was transformed into 40 tonnes of compost and in return the hospital received 10 tonnes of fresh organic produce at a wholesale price of 6000$. In another US hospital, switching from single use to reusable salad plates and dessert bowls, they managed to save 11000$ annually.

2.13 Obstacles for Managing Waste Sustainably

Often there is little incentive to promote higher levels of recycling and indeed in certain market conditions a greater profit might be made by the continued disposal of wastes to landfill. However, there is a demand from the public for more sustainable practices (Norfolk Waste Trust, 2000).

High recycling rates can be easily achieved where money is no object. However, since financial constraints are real, it is essential to identify the cost-effectiveness of initiatives so that the value for money is ensured in any decision to increase recycling (Norfolk Waste Trust, 2000; Murphy et al., 1995).

One of the largest barriers to plastics recycling is the lack of a continuous and reliable supply of quality, sorted materials (Davis and Song, 2006; Perugini et al., 2005).
Some practical difficulties in the recycling of used plastics are (Davis and Song, 2006):

- Difficulties in collection, separation and identification of plastics;
- Limited recycling technologies;
- Degradation due to repeated processing;
- Low bulk density of polymers;
- Availability and low quantities;
- Less economically viable than other feedstock recycling;
- Time consuming.

### 2.14 The Norfolk and Norwich University Hospital

The Norfolk and Norwich University Hospital (NNUH) is located four miles from the center of Norwich, to the South West of the city and off the A47. It opened to patients in November 2001 and the role of the NNUH, as part of the NHS TRUST, is to provide the best possible acute hospital care and treatment for a catchment area of up to 750,000 people. Every year the NNUH staff treats more than 600,000 people from Norfolk, from neighboring counties and from further afield (NNUH, 2007).

The NNUH occupies a 63 acre area, consists of 27 wards, 989 acute beds and 27 operating theatres, equipped with the latest high-tech equipment to aid diagnosis and treatment of patients.

The staff consists of 5,538 people of whom approximately 80% are women and 20% men. The hospital was built by Octagon, a consortium of companies and was rent to the TRUST. SERCO is a private company, employed by NNUH, and provides support services for the TRUST. These include catering, waste management, estates management, portering, transport, parking, post and security, records provision, laundry, archiving and destruction for NHS TRUST (Serco, 2002).
A day in the life of NNUH based on averages includes:

- 2,250 meals and 5,250 drinks served to patients;
- 4,000 meals in the restaurant;
- Consumption of 754 pints of milk and 100 kg of chips.

Obviously the hospital’s catering sector produces large amounts of waste every day, including packaging waste, which currently end up in landfill, with the exception of cardboard which is segregated from the waste stream and recycled. England is running out of landfill sites rapidly and the cost of disposal is increasing each year, due to the landfill tax. Legislation and environmental concerns are key reasons for the NNUH to adopt more sustainable methods of purchasing and waste management.

2.15 Norfolk Environmental Waste Services Ltd.

The Norfolk Environmental Waste Services (NEWS) is a subsidiary of Norfolk County Council (NCC) and is Norfolk’s leading waste management company, providing a wide range of waste management services, including recycling, composting, collection and disposal of waste. The Waste Recycling and Transfer Center at Costessey has the capacity to process 90,000 tonnes of mixed, dry recyclable materials (including paper, cardboard, newsprint, aluminium cans, steel cans and plastic bottles) per annum.

2.16 Overall Objective and Specific Aims

The overall objective of this project is to examine how environmental purchasing activities can lead to less packaging waste in an organization, using the NNUH as a case study and specifically the catering sector. The aims of the project are:

- To review current purchasing activities and practices;
- To identify and quantify the composition of waste streams generated from the catering sector;
• To develop a method for evaluating suppliers using environmental performance criteria, including criteria to assess packaging practices;
• To examine potential for effective waste management of packaging waste, taking into consideration the limitations in Norfolk.
3. RESEARCH METHODOLOGY

3.1 Introduction

This chapter will focus on the different methods that were used to gather the information in order to achieve the research aim and objective of this investigation. Both primary and secondary methods were used for the collection of data.

Primary research has been conducted in order to view and monitor current waste management practices of the NNUH regarding packaging waste produced by the catering sector. This was achieved by conducting a waste audit, as well as a site investigation. People and company opinions and thoughts in relation to the research problem were viewed, with the use of interviews, as well as phone interviews which were based on a designed questionnaire in order to achieve a successful result.

On the other hand, the main reason for secondary research is to understand the research background of the related problem. Literature review related to packaging, packaging waste and other issues directly or indirectly connected to packaging waste management, was conducted continuously throughout the research process.

3.2 Research Process

According to Churchill and Iacobucci (2002), the research design is the framework or plan for a study, used as a guide in collecting and analyzing data. It ensures that the study:

1. Will be relevant to the problem; and
2. Will use economical procedures.

The whole process of the research is illustrated in Figure 3.1.
Continuous literature review of packaging waste management issues and environmental purchasing involvement of suppliers

**Methods Used**

- Site Visits
- Internal Interviews
- Waste Audit
- Supplier Interviews

**Catering Sector**

- Purchasing
- Current Practices
- Suppliers

**Waste Management**

- Supplier Selection Criteria
- Environmental Performance
- Packaging Practices

**Involvement of Suppliers**

- Current Practices
- Analysis of Packaging Waste

**Recommendations**

*Figure 3.1: Research Flow Chart*
In order to ensure validity and achieve the aims of the research, multiple sources of data were used to gather information. Yet, subjectivity when conducting a research is unavoidable (Mohr, 1999).

3.3 Sources of Data

3.3.1 Secondary Research – Literature Review

An initial research was undertaken to understand packaging and packaging waste management. Furthermore, purchasing issues were investigated, since it is an issue directly related to effective waste management methods. The vast majority of the information was collected through internet sources and academic journals and reports, but academic book sources were also very helpful. Literature review was conducted throughout all stages of the research (see Figure 3.1) in order to achieve an understanding of packaging waste management in the catering sector within the healthcare sector. The review encompassed literature on Waste and Packaging Waste; Supply Chain Management and Green Supply Chain Management; Environmental Purchasing; the Role of Suppliers in the supply chain; Healthcare Sector and Norfolk and Norwich University Hospital.

In order to design the waste audit methodology and the questionnaire which was used for the telephone interviews, research case studies, relevant reports and journal articles about packaging waste were used as sources of information.

3.3.2 Primary Research

Primary data collection includes both qualitative and quantitative data, based on observations, interviews, questionnaires and even experimentations. Using these techniques, the data collected are unique to the research (Burns and Bush, 2003).

Qualitative research involves observing and/or asking open-ended questions, usually with a small number of respondents (Burns and Bush, 2003). This direct method of qualitative research to collect primary data was applied to conduct interviews with selected employees of NNUH and NEWS.
Quantitative research is the recording and counting of behavior patterns of people, objects and events in a systematic manner in order to get any information for the related problem (Burns and Bush, 2003). In this research, telephone interviews with suppliers of the NNUH catering sector were conducted with the use of a designed questionnaire.

A disadvantage of primary research is that, in comparison with secondary research, it is more costly and time consuming. All the different methods used to obtain primary data are further analyzed next.

3.4 Site Investigation

An initial walk on the site was undertaken with the purpose of familiarizing with the layout and internal activities of the NNUH catering sector and the waste management sector. In that way good relationships with staff members were established in order to develop and facilitate cooperation. Several other site visits followed, to collect information and data through observation, talking to staff members and recording their opinions about packaging waste.

3.5 Internal Interviews

A qualitative research interview is an attempt to cover both a factual and a meaning level, though it is usually more difficult to interview on a meaning level. An interview is an interchange of views between two persons conversing about a theme of mutual interests and providing data about understandings, opinions, experiences, attitudes, feelings and the like that people have in common (Kvale, 1996).

In order to achieve the project’s objective and aims regarding packaging waste, interviews were conducted with selected key staff members and top management responsible for catering and procurement activities and waste management at NNUH. One representative of NEWS was also interviewed to discuss local waste management potential and limitations. All interviews were conducted in a direct meeting with the interviewees, as the face-to-face interview method was considered the most suitable for the purpose of the study.
The interviewees were initially contacted at an early stage, so that an appropriate time and a comfortable environment would be available for the interview to take place. In order to obtain quality data, the issue of confidentiality was addressed and the interviewer developed a relationship with the interviewees.

All interviews included a predefining range of questions relevant to the research problem, but further probing with additional questions was made when it was considered essential. The information obtained by responses and opinions of the interviewees was recorded and was used to make recommendations.

3.6 Waste Audit

A waste audit is a formal, structured process, used to quantify the amount and types of waste generated by an organization (WRAPP, 2001). A waste audit of the waste produced by the NNUH catering services of the restaurant was considered to be an essential part of the research, in order to assess the composition of waste and packaging waste in particular and the activities that create this waste. Furthermore, the waste audit was able to provide data about the type, origin and quantity of waste produced, but also information regarding the management policies and procedures that affect waste generation. In that way, wasteful practices are identified and potential opportunities to increase efficiency, reduce waste and lower waste management costs, are created.

According to Welford (1998) the waste audit can be divided into three areas of activities (Figure 3.2):

1. Pre-Audit activities;
2. On-Site activities; and
3. Post-Audit activities.
3.6.1 Pre-Audit Activities

Pre-audit activities can contribute greatly to the conduction of a successful waste audit, for the reason that they can minimize the time spent at the site and at the same time maximize the audit team’s productivity (Welford, 1998).

In order to organize the waste audit in the best possible way, an initial meeting with the NNUH Environmental Manager and Waste Manager was scheduled to inform them of the waste audit and discuss issues that would ensure the success of the waste audit. In particular the meeting involved:

- Scheduling the waste audit date;
- Identifying the site selected for the conduction of the waste audit;
• Identifying the storage areas for the waste produced by the catering sector of the restaurant;
• Identifying the individual waste streams that would be encountered during the waste audit and developing a comprehensive recording checklist (Appendices VII & VIII);
• Ensuring that collection and transportation of the waste to the audit site would follow set procedures;
• Ensuring that essential protective clothing and other materials needed, were available;
• Identifying potential problems and limitations encountered during the audit and possible solutions;
• Ensuring that the waste management employees on site, would be informed of the activities during the audit;
• Ensuring that all activities would follow health and safety procedures.

3.6.2 On-Site Activities

The waste audit was conducted during four days from Monday to Thursday. Every day in NNUH, the waste produced by the catering services in the restaurant is placed in two 1100 lt waste wheelie bins located in designated disposal holds. One waste bin is for cardboard only and the other waste bin is for any other type of waste produced by the kitchen.

For every day of the waste audit, the initial step was for the auditor that did the segregation to wear the protective equipment consisting of a protective overall, nose mask, heavy duty gloves and safety boots. A trolley was previously cleaned and washed to ensure that no previous waste remnants were in it. After the waste bins were transported to the site of the waste audit, the black bin bags containing general waste were emptied into the trolley, checked for any harmful materials and then the individual waste types were manually segregated. Each waste stream was placed in a transparent polyethylene bag as shown in the photographs 1, 2, 3 below. Cardboard was already segregated and placed in a different waste bin as mentioned.
After segregation, the next step was to weigh the transparent bags in order to measure the amount of segregated waste and record the measurements on a waste data sheet. The cost of disposing or recycling materials is charged on a weight basis, so weighing the segregated waste was essential. The scale used to weigh the bags of segregated waste was not very sensitive to reading light weight, but since the amounts of waste produced were large, this problem was not considered significant.

### 3.6.3 Post-Audit Activities

Post-audit activities include the evaluation and recording of the findings. Further details regarding weight and other comments about the different waste streams encountered in the waste audit are reported in the Results and Discussion section.
3.7 Supplier Interviews - Questionnaire

Telephone interviews were used as the appropriate method of contacting the suppliers of the NNUH catering sector, in order to obtain information and data regarding their environmental performance and their perception about packaging practices and packaging waste. This method was used, since the number of suppliers was not large (15 suppliers in total). The interviews were based upon a designed questionnaire (Appendix IX), making the interview short and thought provoking for the interviewees. The use of a questionnaire provided a consistent approach to all suppliers, allowing easier analysis and comparisons to be made.

The questionnaire is one of the most widely employed techniques in appraisal (IEMA, 2002). Questionnaires are often used to gather information on supplier environmental performance and the environmental effects of products and services because they:

- Are a familiar technique to purchasing professionals.
- Can appear to offer a cost-effective means of gathering information.
- Can produce substantial amounts of data on suppliers and products.

3.7.1 Questionnaire design

The questionnaire designed for the telephone interviews covered issues to:

- Assess the approach of the interviewed companies towards any environmental pressures;
- Evaluate the environmental performance of the companies, based on issues such as the existence of an environmental policy statement, environmental management system (EMS), etc.;
- Reveal respondent’s awareness about the environmental impacts the company creates;
- Identify current packaging practices used by the companies and relevant problems;
- Reveal attitudes towards changing current packaging practices, in order to generate less packaging waste;
- Reveal how knowledgeable respondents were about the recycling potential within Norfolk.

Since the respondents did not have a copy of the questionnaire at the time of the interview, simple wording and clear language was used throughout the whole interview, to avoid any misunderstandings. Closed and straightforward questions were used and answers were recorded mainly with the use of check boxes, so that answers can be easily analyzed.

### 3.7.2 Conducting the Supplier Interviews

An initial contact with the respondents was made to set up a convenient date and time in order for the interview to take place. The purpose of the survey was explained and confidentiality of any information provided was stressed, to eliminate any concerns about sensitive or confidential information and ensure cooperation.

### 3.7.3 Analysis of the Questionnaire

The aim of the analysis was to produce comments, figure and tables so that the answers of the questionnaire could be easily and effectively visualized and reflected. In particular:

- Microsoft Excel was used for data input and creation of tables;
- The responses of each questionnaire were entered in the appropriate rows and columns created;
- The number of the answers to each question was counted and the percentage representing each answer was calculated;
- Graphs were designed to reflect the results.
4. RESULTS AND DISCUSSION

4.1 Introduction

The results and discussion chapter is divided in three sections. The first section discusses current purchasing and waste management practices. The composition of the different catering waste streams, generated as a result of these current practices is identified and quantified in the second section which presents the waste audit results. The final section presents the supplier interview results, which demonstrate the suppliers’ environmental performance and perceptions about packaging, and thus their involvement in the current packaging waste streams encountered during the waste audit. By combination of the results presented in the three sections, the relation of purchasing activities and packaging waste can be identified. By taking into account the involvement of the suppliers, recommendations can be made about future purchasing and waste management practices that can result in minimizing packaging waste in the catering sector.

4.2 Current Practices

The information about current purchasing and waste management practices was obtained after interviewing employees in the procurement and waste management sector.

4.2.1 Current Purchasing Practices

The NNUH is an organization employing over 5,500 people and responsible for treating over 600,000 people every year. Thus, NNUH demands the purchasing of huge amounts of different products for catering services on site, including:

- Frozen and chilled cooked food;
- Bread and cakes;
- Fruits and salads;
- Frozen and fresh vegetables;
• Sandwiches;
• Desserts;
• Refreshment drinks and juices;
• Milk;
• Water;
• Coffee and tea;
• Other disposable equipment (trays, coffee cups, tissues, etc.).

Some of these products, such as cooked food, drinks, bread, are purchased on a daily basis, while others are purchased on a weekly basis. All of the products purchased are packaged. Packaging methods vary, depending on the product. Some common packaging used is plastic containers, plastic bottles, plastic film, cardboard, steel cans, aluminum cans, plastic pallets, etc.

The nature of the products purchased is based on NNUH and patients’ dietary needs and does not vary greatly throughout the year. The one thing that changes throughout the year is the volume of some products purchased, due to the fact that in winter for example, there is a greater need for cooked meat and less salad, while in the summer more refreshment drinks and water are required. Changes of volume purchased result to changes of the composition of packaging waste generated throughout the year.

The NNUH is a large organization and as part of the NHS TRUST the current purchasing practices are based on criteria formulated by NHS central decisions. NHS Purchasing and Supply Agency (PASA) is one of the leaders in the governmental sector for best practice in procurement. They hold ISO 14001 accreditation which covers procurement activities, with annual objectives and targets covering sustainable procurement. They are involved in the development of environmental purchasing policies and procedures. They also have a Supplier Environmental Questionnaire and operate a number of ongoing initiatives to engage and support SMEs and local procurement.
The main criteria used by NNUH regarding purchasing and selection of suppliers are based on a combination of:

- Quality of products and services;
- Cost; and
- Delivery time.

Good environmental performance of the suppliers is taken into account during the tendering evaluation and any additional certification of the suppliers’ environmental management system (EMS), is considered as an added plus. However, currently there is no specific demand for the suppliers to have an EMS certification (ISO 14001, EMAS, etc.). Occasionally suppliers are being audited by NHS appointed personnel, to view their production practices and ensure good quality of products purchased and services provided, according to NHS STS (Support Training Services) standard for production processes.

A common problem related to the issue of purchasing products is excessive packaging, like in the case of plastic pallets which are not reused by the supplier. It is the case that suppliers of NNUH do not usually ask for feedback regarding these issues, but excessive packaging is reported back to the suppliers as part of the whole communication process.

4.2.2 Current Waste Management Practices

Every day in NNUH, the waste produced by the catering services in the restaurant is placed in two 1100 lt wheelie bins located in an appropriate storage area. One waste bin is for cardboard only and the other waste bin is for general kitchen waste placed in black bin bags. Every time each of these two wheelie bins is full, it is transported to the central collection site, the waste disposal bay. The waste bins are hydraulically lifted and the waste is emptied into the appropriate compactor. There is one for general waste and one for the segregated cardboard. When each waste container is full, the cardboard is sent to recycling and the general waste is landfilled.
NEWS is responsible for managing the waste produced by the NNUH catering sector and provides recommendations and advice about effective waste management practice through constant cooperation and communication with the NNUH’s Environmental Management and Waste Management authorities.

Table 4.1 below, presents current waste management practices regarding waste generated from the catering sector (packaging waste and food waste) and also best waste management practices for each waste stream, according to the waste hierarchy (see Fig. 2.1)

<table>
<thead>
<tr>
<th>Waste streams from catering sector</th>
<th>Current Practice</th>
<th>Best Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel cans</td>
<td>Landfill</td>
<td>Recycle</td>
</tr>
<tr>
<td>Aluminium cans</td>
<td>Landfill</td>
<td>Recycle</td>
</tr>
<tr>
<td>Recyclable plastic</td>
<td>Landfill</td>
<td>Recycle</td>
</tr>
<tr>
<td>Plastic pallets</td>
<td>Landfill</td>
<td>Reuse – Recycle</td>
</tr>
<tr>
<td>Food contaminated plastic</td>
<td>Landfill</td>
<td>Landfill</td>
</tr>
<tr>
<td>Non-recyclable plastic (cups, bags, film, etc.)</td>
<td>Landfill</td>
<td>Landfill</td>
</tr>
<tr>
<td>Glass*</td>
<td>Landfill</td>
<td>Reuse</td>
</tr>
<tr>
<td>Tissues and kitchen paper</td>
<td>Landfill</td>
<td>Landfill</td>
</tr>
<tr>
<td>Cardboard</td>
<td>Recycle</td>
<td>Recycle</td>
</tr>
<tr>
<td>Compostable food waste</td>
<td>Landfill</td>
<td>Compost</td>
</tr>
<tr>
<td>Non compostable food waste</td>
<td>Landfill</td>
<td>Landfill</td>
</tr>
</tbody>
</table>

* Glass is currently not recycled at NEWS

It is clear that there is a great potential for improving current waste management practices, since best available waste management practices are followed only in one out of seven (14%) waste streams that can be diverted from landfill. Not only are there environmental benefits, but economic benefits as well, resulting from the reduction of the disposal costs. This is better illustrated in table 4.2 below which shows the cost of disposing or recycling a tonne of waste at NEWS for years 2007-2008 and 2008-2009. The total cost of landfilling is calculated when adding landfill...
tax for active waste and operational costs of NEWS. The total cost for recycling is substantially lower than cost of landfilling, making this option far more attractive and profitable.

**Table 4.2**: Cost of landfill and recycling at NEWS

<table>
<thead>
<tr>
<th>Year</th>
<th>Landfill tax for active waste (per tonne)</th>
<th>Operational cost (per tonne)</th>
<th>Total cost of landfilling (per tonne)</th>
<th>Cost for recycling (per tonne)</th>
<th>Profit when recycling instead of landfilling (per tonne)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007-2008</td>
<td>£24</td>
<td>£41</td>
<td>£65</td>
<td>£10</td>
<td>£55</td>
</tr>
<tr>
<td>2008-2009</td>
<td>£32</td>
<td>*£43</td>
<td>£75</td>
<td>*£10,5</td>
<td>£64,5</td>
</tr>
</tbody>
</table>

* The operational cost of landfill and cost for recycling for the year 2008-2009 is estimated to be 5% higher than the previous year (NEWS, 2007)

In addition to environmental and economic benefits, improving waste management practices at NNUH will enhance the public image of the organization, which after all, is a symbol of health in the community and that means avoid causing any environmental damage.

**4.3 Waste Audit**

This section describes the waste streams found during the four day waste audit. The audit establishes a baseline indicator from which the effectiveness of current waste management practices can be analyzed. The composition of the different waste streams is presented graphically in figure 4.1. The actual weight of these waste streams is shown in Appendix X.
Two future practice scenarios are analyzed to show the opportunity cost for diverting some waste streams from landfill:

1. The ‘No action’ scenario, when waste management practices stay the same and all waste apart from cardboard is landfilled. Cost of landfill is estimated up to 2012;
2. The ‘action’ scenario, when recyclable materials are diverted from landfill. Cost of recycling is estimated up to 2012.

A normal day at the NNUH catering sector produces waste that fills on average 8 wheelie bins of general waste and 5 wheelie bins containing cardboard. Of course these figures may vary depending on deliveries made on specific days, which for example can increase the cardboard packaging waste. Due to the limitations of the waste audit in time and available personnel, it was not possible to audit the waste in every single wheelie bin. Every day three wheelie bins of general waste and one containing cardboard were examined. The total of waste which was looked at during the four day waste audit is equivalent to 12 wheelie bins of general waste and 4 wheelie bins of cardboard. Therefore, it is right to say that the waste audit results provide trends, not proof (Green Steps, 2005) and offer only a snapshot of the current waste management practices.

Figure 4.1: Composition of general waste
Non-recyclable plastics were the largest amount in the waste stream, weighing 26.54% (146.5kg) of total. These include both food contaminated plastics and other types of plastics that are not recycled. Food contaminated plastics consist containers and tubs containing food, sauce, etc. The other types of plastic which cannot be recycled are mainly vending drink cups, other disposable drinking cups, disposable containers, plastic film and bags.

Compostable and non-compostable food waste was the second and third largest component with 18.03% (99.5kg) and 16.39% (90.5kg) of the total waste respectively. Compostable food waste consisted mostly of vegetable and fruit leftovers and coffee. Non-compostable food waste included meat and fish leftovers, beans, eggs, sandwiches and other cooked food. It has to be noted that both of these two waste streams should not have been encountered at all during the waste audit, because according to current NNUH waste management practices, food waste is expected to be disposed off separately from the other waste produced by the catering sector.

Steel cans weighed 11.78% (65kg) of total and were mainly cans of food and dessert products. Steel cans were the largest amount of waste encountered in the general waste category with a potential for recycling. The next potentially recyclable waste stream was recyclable plastics, weighing 6.89% (38) of total waste. Recyclable plastics included mainly milk bottles and some plastic cold drink and water bottles.

Cardboard was already segregated and placed in a different disposal bin as mentioned before. The weight of cardboard as measured during the waste audit by looking into 4 cardboard disposal bins is shown in table 4.3 below.

<table>
<thead>
<tr>
<th>Waste Stream</th>
<th>Weight (kg)</th>
<th>Average weight per wheelie bin (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardboard</td>
<td>116</td>
<td>29</td>
</tr>
</tbody>
</table>

The weight of cardboard in each wheelie bin varied from 24 to 33 kg. This fluctuation is due to the fact that in some wheelie bins all the cardboard was flattened,
while in others some of the cardboard was not flattened and thus was occupying more space.

Based on the weight measurements of general waste and cardboard made for 12 and 4 wheelie bins respectively, the total daily production of catering waste can be calculated. This can be achieved by taking into account that in a normal day at the NNUH, the catering sector produces on average general waste that fills 8 wheelie bins (1100lt), and cardboard that fills 5 wheelie bins (1100lt). The actual weight measurements are shown in Appendix XI and the composition of the different waste streams (including cardboard) is illustrated in Figure 4.2 below.

![Figure 4.2: Composition of waste produced daily from the catering sector](image)

Cardboard is the predominant waste stream consisting of 28.18% of the total waste production every day. Cardboard is currently sent to recycling which means that 145kg (on average) of cardboard produced only by the catering sector is diverted from landfill each day. This is equivalent to more than a tonne of cardboard diverted from landfill each week and more than 52 tonnes each year. The environmental benefits due to this waste management practice are many. More space is saved in landfills and landfill gas emissions are reduced, to name some. Moreover, this practice can result in cost savings.

Regarding packaging waste only, table 4.4 below shows the total amount of packaging waste which is currently landfilled, and the total amount of the packaging
waste which could have been diverted from landfill, if it was recycled. Estimated figures per year are based upon the fact that the catering sector at NNUH is active every day of the year, thus 365 days.

Table 4.4: Weight of all packaging waste and recyclable packaging waste landfilled

<table>
<thead>
<tr>
<th>Waste Stream</th>
<th>Waste landfilled per day (kg)</th>
<th>Waste landfilled per year (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All packaging waste *</td>
<td>177.5</td>
<td>64787</td>
</tr>
<tr>
<td>Recyclable packaging waste **</td>
<td>74.5</td>
<td>27193</td>
</tr>
</tbody>
</table>

** Recyclable packaging waste: steel cans, plastic pallets, aluminium cans and recyclable plastics
* All packaging waste: Includes recyclable packaging waste, non-recyclable plastics and glass which is not recycled at NEWS currently

Recyclable packaging waste consists of 42% of all packaging waste which is currently sent to landfill. Cardboard is not included, because it is already recycled and thus diverted from landfill. What this table shows is that over 27 tonnes of packaging waste could have been diverted from landfill if it was recycled, which could have both environmental and economic benefits.

4.3.1 Diverting Waste from Landfill

The two future practice scenarios are analyzed next in order to show the opportunity costs for diverting recyclable waste streams from landfill. These waste streams are steel and aluminium cans, recyclable plastic and plastic pallets (see table 4.1). Plastic pallets can be reused, but in this case they will be considered as recyclables only. The data derived from the waste audit are used to make projections about the daily and yearly (365 days) waste production of 2007-2008 and assume that the waste composition and weight will not change during a five year scale up to 2011-2012. The costs are calculated taking into account that all landfilling and recycling would be managed by NEWS.
According to the ‘No Action’ scenario all waste management practices stay the same. Table 4.5 shows the cost of landfilling recyclable waste streams up to 2011-2012. The ‘Action’ scenario encompasses the recycling of the waste streams that have a recycling potential and the cost for recycling until 2011-2012 is shown in table 4.6.
Table 4.5: ‘No Action’ scenario: Estimated landfilling costs from 2007 to 2012

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel cans</td>
<td>43.5</td>
<td>15877.5</td>
<td>£1032</td>
<td>£1191</td>
<td>£1350</td>
<td>£1516</td>
<td>£1683</td>
</tr>
<tr>
<td>Aluminium cans</td>
<td>3</td>
<td>1095</td>
<td>£71</td>
<td>£82</td>
<td>£93</td>
<td>£104.5</td>
<td>£116</td>
</tr>
<tr>
<td>Recyclable plastic</td>
<td>25.5</td>
<td>9307.5</td>
<td>£605</td>
<td>£698</td>
<td>£791</td>
<td>£889</td>
<td>£987</td>
</tr>
<tr>
<td>Plastic pallets</td>
<td>2.50</td>
<td>913</td>
<td>£59</td>
<td>£68.50</td>
<td>£77.5</td>
<td>£87</td>
<td>£97</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>74.50</strong></td>
<td><strong>27193</strong></td>
<td><strong>£1767</strong></td>
<td><strong>£2039.50</strong></td>
<td><strong>£2311.5</strong></td>
<td><strong>£2596.50</strong></td>
<td><strong>£2883</strong></td>
</tr>
</tbody>
</table>

* Landfill Cost is calculated by adding Landfill Tax (active wastes) and Operational Costs of NEWS

  Landfill Tax (active wastes) increases £8 per tonne per year to at least 2010-2011 (DEFRA, 2007). It is assumed that the increase will be similar for 2011-2012

  Operational Costs of NEWS increase by 5% per annum (NEWS, 2007)
Table 4.6: ‘Action’ scenario. Estimated recycling costs from 2007 to 2012

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel cans</td>
<td>43.5</td>
<td>15877.5</td>
<td>£159</td>
<td>£167</td>
<td>£175</td>
<td>£182.50</td>
<td>£190.50</td>
</tr>
<tr>
<td>Aluminium cans</td>
<td>3</td>
<td>1095</td>
<td>£11</td>
<td>£11.50</td>
<td>£12</td>
<td>£12.50</td>
<td>£13</td>
</tr>
<tr>
<td>Recyclable plastic</td>
<td>25.5</td>
<td>9307.5</td>
<td>£93</td>
<td>£98</td>
<td>£102</td>
<td>£107</td>
<td>£112</td>
</tr>
<tr>
<td>Plastic pallets</td>
<td>2.50</td>
<td>912.5</td>
<td>£9</td>
<td>£9.50</td>
<td>£10</td>
<td>£10.50</td>
<td>£11</td>
</tr>
<tr>
<td>TOTAL</td>
<td>74.50</td>
<td>27193</td>
<td>£272</td>
<td>£286</td>
<td>£299</td>
<td>£312.50</td>
<td>£326.50</td>
</tr>
</tbody>
</table>

* Recycling Cost at NEWS is estimated to increase by 5% per annum (NEWS, 2007)
The above tables show that current waste management practices at the NNUH sent 27193kg of packaging waste to landfill every year, which could have been avoided if the preferred method of waste management was recycling. Besides environmental impacts, this method of waste management is also unprofitable. The cost of landfilling for 2007-2008 and 2011-2012 would be £1767 and £2883 respectively. The cost for recycling for 2007-2008 and 2011-2012 would be £272 and £326.50. The net savings for NNUH over the five year period would be £10101. It is clear that the ‘Action’ scenario results in both environmental and economic profits.

4.4 Supplier Interviews

15 major suppliers of the NNUH catering sector were identified and contacted by telephone in order to obtain information and data regarding their environmental performance and their perception about packaging practices and packaging waste. The successful interviews were 13, since in two cases the interviewees were not available. The designed questionnaire used for the interviews is shown in Appendix IX. It consists of 3 parts and 17 questions in total. The different parts are analyzed next.

4.4.1 General Information – Background of Respondents

Eight of the interviewed companies provide NNUH with food or drink products, while the other five supply general disposable equipment and other general catering equipment. The size of the companies ranges from huge multinational organizations to much smaller businesses. The selected representatives of each company, selected for the interview, were mainly purchasing managers and in some cases environmental managers.

4.4.2 Suppliers Environmental Performance

According to Enarsson (1998) there is no real tool to practically measure a supplier’s environmental status. What this part of the questionnaire attempts to achieve is to provide information about the overall environmental performance of the suppliers interviewed, and examine whether their current environmental policies and practices actually address the key impacts of their business.
All of the 13 interviewed suppliers agree that their company faces environmental pressures. The majority of them (69%) deal with these pressures proactively and environmental considerations are included in the company’s activities (see figure 4.3 below). The rest of the companies deal with environmental pressures by ensuring that they fulfill all legislative requirements, but they do not take any further action.

![Figure 4.3: Dealing with environmental pressures](image)

These pressures originate from various sources shown in figure 4.4 below. The most common group of environmental pressure was the company’s customers, who are becoming increasingly environmental conscious and demand environment-friendly products. Government plays a significant role in putting pressure on companies through environmental legislation (Humphreys et al., 2003) and this is clearly shown in figure 4.4. On the contrary, environmental pressure groups and media are not considered that significant.

![Figure 4.4: Groups that create environmental pressure on companies](image)
All 13 interviewed suppliers have an environmental policy statement and an Environmental Management System (EMS) in place. Most of the suppliers expressed their opinion that an EMS of some form is an essential tool for every company for managing environmental impacts and even enhancing production procedures. However, as it is shown in figure 4.5, most of the EMSs in place in the different companies were not certified (69% of companies). ISO 14001 was the only certified EMS adopted by 4 companies in total.

![Figure 4.5: EMS in companies](image)

![Figure 4.6: Perception of how successful the EMS has been](image)

Nine companies with an EMS in place said that their EMS has been successful so far, while two companies expressed the opinion that their EMS has been only marginally successful (see figure 4.6 above). On the contrary two companies thought that their EMS has been a very successful tool so far and it has to be noted that both of them had certified EMSs. There were no responses considering unsuccessful EMSs.

Having asked about their EMS, the questionnaire further asked suppliers to name the top five environmental impacts of their companies (see figure 4.7 below). The major impacts identified by all 13 suppliers were: waste; water consumption (during production and washing); and energy consumption (refrigerating, lighting, heating and operating equipment). Packaging waste was considered the most important waste stream. Concerns were also raised for the issue of transport emissions and climate change due to cumulative emissions. The depletion of other natural resources resulting from extraction of raw materials for production purposes was also considered an important impact in many companies. One impact considered as less
important was pollution risk from fuel spillages because of precautions taken in the storage and use of fuel.

![Bar chart showing top environmental impacts of companies](image)

**Figure 4.7:** Top Environmental Impacts of companies

In order to examine whether the companies are taking any measures to improve their environmental performance, they were asked if they set environmental performance targets and objectives against which performance can be audited. The responses show that 85% of suppliers do it (see figure 4.8 below). The more common examples given involve improving efficiency of energy use ratio, water use ratio and improve solid waste generation ratio within a specific period of time which usually ranges between 3-5 years.

![Pie chart showing percentage of companies setting environmental objectives and targets](image)

**Figure 4.8:** Percentage of companies setting environmental objectives and targets

![Pie chart showing percentage of companies communicating environmental objectives and targets](image)

**Figure 4.9:** Percentage of companies communicating environmental objectives and targets to customers

As far as the communication of these objectives and targets is concerned, all eleven companies that currently set these targets and objectives communicate them to
their employees and to any interested parties that request further information. Further more, 45% of the companies communicate these objectives and targets to their customers (see figure 4.9 above) even before customers request such information. All of the eleven companies setting environmental objectives and targets conduct a formal report on progress towards meeting these objectives and targets, included usually in their annual report.

The final question off this part of the questionnaire was if the company had been found guilty of any infringement of environmental legislation in the past three years. All 13 companies answered negatively and the majority stated that legislation compliance has been always a top priority of their organization.

4.4.3 Suppliers Perception and Current Packaging Practices

In order to assess current packaging practices, suppliers were asked to identify the top 5 criteria used for the selection of materials that consist in their packaging. The responses are presented in figure 4.10 below.

![Figure 4.10: Top criteria for the selection of packaging materials](image)

Cost, product safety, product hygiene and quality were among the top criteria for all suppliers. Presentation was also considered an important criterion, while potential for recycling and reuse were not among the top criteria in many responses.
The problem with excessive packaging is well known and faced by many purchasers, when it comes to disposing packaging waste. However, figure 4.11 shows that only 23% of customers has reported unnecessary packaging to their suppliers, mainly in the case of reusable packaging, such as plastic pallets.

9 out of 13 suppliers stated that they do not use reused materials in packaging and all materials are extracted raw (see figure 4.12 above). The materials which are currently reused in most cases are plastic pallets.

Hazardous or harmful materials are not used by any supplier. This relates back to figure 4.10 where all suppliers identified product hygiene to be one of their main criteria for selection of the packaging materials.

Since the current packaging practices of the suppliers can be further improved, they were asked if they would consider changing practices to generate less packaging (Figure 4.13). Furthermore they were asked to state some of the methods they would choose (figure 4.14).
Eleven suppliers answered positively to the issue of considering changing some of their current practices in order to generate less packaging. The preferred methods were the use of returnable packaging (e.g. plastic pallets) and the use of lighter materials. Two suppliers said that they are not considering changing any practices, due to the associated costs of implementing these practices.

Environmental research is essential if a company wants to improve environmental impacts resulting from its packaging waste. It is both time and cost consuming and only three suppliers are currently conducting such a research (Figure 4.15) while others stated that it could be one of their future plans.
Figure 4.15: Percentage of suppliers conducting research to improve environmental impacts of packaging

The interview’s final question relates to the potential and limitation of recycling in Norfolk. Suppliers were asked if their packaging can be recycled in Norfolk (see figure 4.16 below) and five said that some of their packaging can be recycled while 3 said that all of their packaging can be recycled in Norfolk. However five suppliers were not sure about what can be recycled in Norfolk.

Figure 4.16: Companies’ perception about packaging recycling potential in Norfolk

The responses of the suppliers show their perception and current packaging practices. Suppliers have a direct connection with NNUH through purchasing. Therefore, it is feasible to examine the role they play in the packaging waste production of the NNUH’ catering facilities.
4.5 Limitations of the Research

The research looked at waste produced by the NNUH catering sector and focused particularly on packaging waste. The limitations in the method and analysis are the following:

- The waste audit was conducted during four days and thus can offer a snapshot of the NNUH waste management practices. In order to obtain more data, the waste audit could have lasted longer but this was not feasible due to time and personnel constraints.
- On each day of the waste audit only 3 out of 8 general waste bins and 1 out of 5 cardboard waste bins was looked at. Due to the lack of personnel for the waste audit, it was not feasible to look at the total daily amount of waste. The composition of waste in each bin was different, depending on the time of day, because different catering activities take place during the day. This problem was tackled by looking at waste bins at different time zones on each day, although it was not feasible to look at waste generated at late hours of the day.
- The estimated landfilling and recycling cost from 2007 to 2012 (tables 4.5 and 4.6) according to the ‘No Action’ and ‘Action’ scenarios are based on the assumption that the composition and weight of waste produced by NNUH catering sector will not change during the five year scale.
- 13 out of the 15 selected suppliers of the NNUH catering sector were successfully contacted. Efforts to contact the remaining two suppliers eventually stopped due to time implications.
5. CONCLUSIONS

5.1 Summary

Economic instruments such as landfill tax which is increasing by £8 annually, raises the cost of waste disposal. Furthermore, the environmental impacts associated with landfill make it the least preferable waste management method.

Effective environmental purchasing practices can reduce sources of waste and promote recycling and recovery of purchased materials. As a result, more waste is diverted from landfill.

The case study of the NNUH highlights the issue of applying environmental purchasing practices in order to deal with waste more sustainably, focusing on packaging waste generated from the catering sector. Internal interviews were conducted with selected key staff members and top management responsible for catering and procurement activities at NNUH. Current practices show that good environmental performance of the suppliers is taken into account during the tendering evaluation, but it is not one of the main criteria for selection.

The waste audit showed that apart from cardboard which is recycled, best waste management practices are not followed for the other recyclable waste streams. It is estimated that 77kg of recyclable packaging waste (44% of all packaging waste) is landfilled every day. Financial savings could be made by employing the 3Rs (reduce, reuse and recycle) and profit made when recycling instead of landfilling was calculated for up to 2012.

The supplier interviews revealed that suppliers are generally aware of the environmental impacts of their business and were particularly concerned about packaging waste. 85% of companies stated that they would consider changing their practices to generate less packaging, but only 23% is currently conducting research on that issue.
There are barriers to minimize packaging waste sent to landfill due to lack of initiatives focusing on diverting more waste streams from landfill, difficulties in changing current procurement policies, lack of recycling facilities where packaging waste could be segregated, perception that segregation could increase costs, and contamination of waste streams. Suggested recommendations to overcome these barriers are analyzed in chapter 6.
6. RECOMMENDATIONS

6.1 Introduction

Recommendations are given to enhance environmental purchasing practices. The waste hierarchy is used to recommend methods to implement effective waste management procedures.

6.2 Environmental Purchasing Recommendations

Some recommended issues to enhance environmental purchasing practices are:

- Secure commitment at a senior level by emphasizing cost savings;
- Develop an environmental purchasing strategy integrated with the organization’s overall business objectives and strategies;
- Ensure appropriate training of environmental purchasers;
- Highlight that environmental purchasing reduces waste and increases efficiency;
- Ask suppliers to commit to environmental performance enhancement goals such as minimization of packaging, use of reusable and recyclable packaging, pallets and containers, make use of reverse logistics;
- Ask for reusable packaging in situations with low transport distances and high return rates and one-way packaging in situations with generally high transport distances and low return rates;
- Choose packaging where the materials can be easily reused or recycled;
- Buy recycled materials wherever possible;
- Buy plastics manufactured from fewer types of polymer clearly labeled;
- Buy biodegradable packaging or products made of ‘bioplastics’\(^1\) for single use disposable items;
- Consider concentrating products, so that they can fit into smaller packs;

\(^1\) Bioplastics are derived from natural renewable resources: starch, sugar or plant oil (Davis and Song, 2006; WRAP, 2007).
• Underline the fact that environmental purchasing can enhance the social and corporate image.

6.3 Effective Waste Management Recommendations

Effective Waste Management Recommendations are as follows:

• Ensure effective communication between staff and management;
• Educate all catering staff members of the importance of the 3R’s approach;
• Appoint environmental champions to devise communication systems, encourage recycling in the catering sector, provide feedback and measure effectiveness;
• Introduce collection points for recyclable waste including steel cans, recyclable plastic bottles and aluminium cans;
• Introduce compost collection points for green waste;
• Set up waste minimization techniques and review progress against set targets;
• Raise environmental awareness.
ABBREVIATIONS AND ACRONYMS

EU: European Union
EMS: Environmental Management System
EP: Environmental Purchasing
GSCM: Green Supply Chain Management
NCC: Norfolk County Council
NEWS: Norfolk Environmental Waste Services
NNUH: Norfolk and Norwich University Hospital
SCM: Supply Chain Management
REFERENCES


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APPENDICES

APPENDIX I

Annex 1:

Categories of waste as set out in the 1975 Waste Framework Directive (as amended)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Production or consumption residues not otherwise specified below.</td>
</tr>
<tr>
<td>2</td>
<td>Off-specification products.</td>
</tr>
<tr>
<td>3</td>
<td>Products whose date for appropriate use has expired.</td>
</tr>
<tr>
<td>4</td>
<td>Materials spilled, lost or having undergone other mishap including any</td>
</tr>
<tr>
<td></td>
<td>materials, equipment, etc., contaminated as a result of the mishap.</td>
</tr>
<tr>
<td>5</td>
<td>Materials contaminated or soiled as a result of planned actions (e.g., residues</td>
</tr>
<tr>
<td></td>
<td>from cleaning operations, packing, materials, containers, etc.).</td>
</tr>
<tr>
<td>6</td>
<td>Unusable parts (e.g., reject batteries, exhausted catalysts, etc.).</td>
</tr>
<tr>
<td>7</td>
<td>Substances which no longer perform satisfactorily (e.g., contaminated acids,</td>
</tr>
<tr>
<td></td>
<td>contaminated solvents, exhausted tempering salts, etc.).</td>
</tr>
<tr>
<td>8</td>
<td>Residues of industrial processes (e.g., slags, still bottoms, etc.).</td>
</tr>
<tr>
<td>9</td>
<td>Residues from pollution abatement processes (e.g., scrubber sludges, baghouse</td>
</tr>
<tr>
<td></td>
<td>dusts, spent filters, etc.).</td>
</tr>
<tr>
<td>10</td>
<td>Machining of finishing residues (e.g., lathe turnings, mill scales etc.).</td>
</tr>
<tr>
<td>11</td>
<td>Residues from raw materials extraction and processing (e.g., mining residues,</td>
</tr>
<tr>
<td></td>
<td>oil field slops, etc.).</td>
</tr>
<tr>
<td>12</td>
<td>Adulterated materials (e.g., oils contaminated with PCB’s etc.).</td>
</tr>
<tr>
<td>13</td>
<td>Any materials or products whose use has been banned by law.</td>
</tr>
<tr>
<td>14</td>
<td>Products for which the holder has no further use (e.g., office, agricultural,</td>
</tr>
<tr>
<td></td>
<td>household, commercial and shop discards, etc.).</td>
</tr>
<tr>
<td>15</td>
<td>Contaminated materials, substances or products resulting from remedial action</td>
</tr>
<tr>
<td></td>
<td>with respect to land.</td>
</tr>
<tr>
<td>16</td>
<td>Any materials, substances or products which are not contained in the above categories.</td>
</tr>
</tbody>
</table>

APPENDIX II: Codes for different plastics

<table>
<thead>
<tr>
<th>Polymer Type</th>
<th>CEN Recommendation CEN WI 261 070</th>
<th>EU Commission Decision 97/129/EC</th>
<th>APME Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyethylene Terephthalate</td>
<td>01 PET</td>
<td>1 PET</td>
<td>1 PET</td>
</tr>
<tr>
<td>High Density Polyethylene</td>
<td>02 PE-HD</td>
<td>2 HDPE</td>
<td>2 HDPE</td>
</tr>
<tr>
<td>Polyvinyl Chloride</td>
<td>03 PVC</td>
<td>3 PVC</td>
<td>3 PVC</td>
</tr>
<tr>
<td>Low Density Polyethylene</td>
<td>04 PE-LD</td>
<td>4 LDPE</td>
<td>4 LDPE</td>
</tr>
<tr>
<td>Polypropylene</td>
<td>05 PP</td>
<td>5 PP</td>
<td>5 PP</td>
</tr>
<tr>
<td>Polystyrene</td>
<td>06 PS</td>
<td>6 PS</td>
<td>6 PS</td>
</tr>
<tr>
<td>Unallocated References</td>
<td>Unallocated</td>
<td>87-19</td>
<td>07/49</td>
</tr>
</tbody>
</table>

Source: Waste Online (2001)
APPENDIX III: UK Packaging waste arisings and projections


Chart C8.2: Packaging waste arisings and projections by material – UK estimates (1999–2010)

Source: DEFRA (2007)
### APPENDIX IV: Examples of waste minimization by producers and retailers

<table>
<thead>
<tr>
<th>Company</th>
<th>Waste minimisation measures</th>
<th>Reduction in packaging waste (percentage/tonnage reduction per annum)</th>
<th>Savings per annum (where known)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedigree Master Foods</td>
<td>Redesign and lightweighting of primary and transit packs (corrugated and carton-board)</td>
<td>49% corrugated (and accompanying inks) 12% carton-board</td>
<td>£100,000</td>
</tr>
<tr>
<td>Nestle</td>
<td>Machinery modification to eliminate inner collation wrap on Kit-Kat multi-pack</td>
<td>100 tonnes</td>
<td></td>
</tr>
<tr>
<td>Sainsbury’s</td>
<td>Garlic bread single plastic sleeve from carton-board and plastic combination</td>
<td>160 tonnes</td>
<td></td>
</tr>
<tr>
<td>Boots</td>
<td>Reusable sandwich trays</td>
<td>163 tonnes</td>
<td>£500,000</td>
</tr>
<tr>
<td>Guinness</td>
<td>Label glue supply from 25 kg pallets to 1 te. Intermediate bulk containers (IBCs)</td>
<td>1.5 tonnes</td>
<td>£20,500 (savings on glue purchase and wastage)</td>
</tr>
<tr>
<td>Hoechst Trespahan</td>
<td>Single-trip to reusable transport system for PP film</td>
<td>50% reduction</td>
<td>£100,000</td>
</tr>
<tr>
<td>Ford</td>
<td>Single-trip to reusable transport system for component manufacturers (~100)</td>
<td>23,000 tonnes</td>
<td></td>
</tr>
<tr>
<td>Herman Miller (office furniture)</td>
<td>Redesign of transit packaging from single-trip to multi-trip</td>
<td></td>
<td>£115,000</td>
</tr>
<tr>
<td>Rexam Medical Packaging</td>
<td>Improved production</td>
<td>36% reduction in process waste</td>
<td></td>
</tr>
<tr>
<td>GE Lighting</td>
<td>Change in primary and transit packaging for fluorescent tubes</td>
<td>20% reduction</td>
<td></td>
</tr>
</tbody>
</table>

Source: DEFRA (2007)
APPENDIX V: Graph of the GSCM

Source: Hervani et al., (2005)
**APPENDIX VI:** A comparison between recycling and reusing

<table>
<thead>
<tr>
<th></th>
<th>Recycling</th>
<th>Reusing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key activities</strong></td>
<td>Collecting, separating, processing and remanufacturing (including composting organic materials)</td>
<td>Sorting, re-circulating, redistributing, refurbishing and repairing without remanufacturing</td>
</tr>
<tr>
<td><strong>Target source</strong></td>
<td>Solid waste</td>
<td>Second-hand products</td>
</tr>
<tr>
<td><strong>End results</strong></td>
<td>New product for new usage</td>
<td>The same form of products for the same usage</td>
</tr>
<tr>
<td><strong>Best application area in supply chain</strong></td>
<td>Manufacturing stage</td>
<td>Distribution stage</td>
</tr>
</tbody>
</table>

Source: Min and Galle (2001)
### APPENDIX VII: NNUH – Catering Waste Audit Data Sheet

Date:  | Audit team:  | Number of bins:  
---|---|---
Bin type: General kitchen waste  | Bin location:  | Number of bags:  

<table>
<thead>
<tr>
<th>WASTE STREAM</th>
<th>DATE/TIME/INITIALS</th>
<th>WEIGHT (kg)</th>
<th>COMMENTS AND OBSERVATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel cans</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminium cans</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recyclable plastic (bottles, containers)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic pallets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food contaminated plastic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other non-recyclable plastic (cups, bags, film, etc)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glass bottles and jars</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kitchen paper and tissues</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compostable food waste</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non compostable food waste</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other non-recyclables (textiles, cloths, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td></td>
<td>86</td>
<td></td>
</tr>
</tbody>
</table>


## APPENDIX VIII: NNUH – Catering Waste Audit Data Sheet (Cardboard)

<table>
<thead>
<tr>
<th>WASTE STREAM</th>
<th>DATE/TIME/INITIALS</th>
<th>WEIGHT (kg)</th>
<th>COMMENTS AND OBSERVATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardboard</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total:**
APPENDIX IX: Supplier Interview Questionnaire

Questionnaire Survey

This questionnaire survey aims to collect information regarding environmental performance and packaging practices of the suppliers of the Norfolk and Norwich University Hospital’s catering sector. The information provided will be treated as confidential and used only for the purpose of the research. No company or individual will be identifiable in any published work.

PART A: General Information

Company Name

What is your role in the company?

PART B: Environmental Performance

1. Are there any environmental pressures on your company?

   Yes  [ ]  No  [ ]

   If YES, how do you deal with these pressures?

   A. A proactive approach is taken to include environmental considerations in the company’s activities.
   B. The company just fulfills the environmental legislative requirements.
   C. Other (please specify)

   [ ]

   If NO, go to question 3
2. Who is creating these pressures? (please select all that applies).

<table>
<thead>
<tr>
<th>Government</th>
<th>Media</th>
<th>Customers</th>
<th>Environmental Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other stakeholders (Please identify)

3. Does your company have an environmental policy statement?

Yes [ ] No [ ]

4. Does your company have an Environmental Management System?

Yes, certified [ ] Yes, but not certified [ ] No [ ]

i) If YES, which one?

A. ISO 14001
B. EMAS
C. Other (please specify) [ ]

a) How successful do you think your environmental management system has been?

Unsuccessful [ ] Marginally successful [ ] Successful [ ] Very successful [ ] I do not know [ ]

ii) If NO, has your company undertaken a review of its environmental impact?

Yes [ ] No [ ] (If NO, go to Question 7)
6. Please name the top 5 environmental impacts of your company

1. 
2. 
3. 
4. 
5. 

7. Does your company set environmental performance targets and objectives against which performance is audited?

Yes [ ] No [ ]

**If YES, please give examples**

1. 
2. 
3. 

**If NO, go to question 10**

8. Does your company communicate environmental objectives and targets to:

Employees [ ] Yes [ ] No [ ]

Customers [ ] Yes [ ] No [ ]

Interested parties [ ] Yes [ ] No [ ]

[ ] Yes [ ] No
9. Does your company formally report on progress towards meeting these objectives?

Yes [ ] No [ ]

10. Has your company been found guilty of any infringement of environmental legislation in the past 3 years?

Yes [ ] No [ ]

If YES, please provide brief details, the date and the outcome of the prosecution.

PART C: Perception and current packaging practices

11. What criteria does your company use for the selection of materials used in packaging?
   (please identify top 5 criteria, starting from the one which is more important)

   1. 
   2. 
   3. 
   4. 
   5.
12. Has your company had any feedback from customers reporting excessive/unnecessary packaging?

Yes  No

**If YES**, what action has your company taken?

13. Does your company use reused materials in packaging?

Yes, in all packaging       Yes, in some packaging    No, all materials are extracted raw

14. Does your company use any hazardous materials in packaging?

Yes  No

15. Would your company consider changing practices to generate less packaging?

Yes  No
If YES, which one? (please select all that applies)

Use of lighter materials □  Compostable packaging □
Returnable packaging □  Use of recycled materials □
Other (please specify) □

16. Does your company currently conduct any research to improve environmental impacts resulting from its packaging waste?

Yes □  No □

17. Do you know if the packaging that your company uses can be recycled within the Norfolk area?

Yes, all of the packaging □  Yes, some of the packaging □  None □  I do not know/ I am not sure □

THANK YOU VERY MUCH FOR YOUR HELP IN COMPLETING THIS QUESTIONNAIRE
**APPENDIX X**: Composition and weight of general waste during the waste audit of 12 wheelie bins

<table>
<thead>
<tr>
<th>Waste Stream</th>
<th>Weight (kg)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel cans</td>
<td>65</td>
<td>11.78</td>
</tr>
<tr>
<td>Aluminium cans</td>
<td>4.50</td>
<td>0.82</td>
</tr>
<tr>
<td>Recyclable plastics</td>
<td>38</td>
<td>6.89</td>
</tr>
<tr>
<td>Plastic pallets</td>
<td>3.50</td>
<td>0.63</td>
</tr>
<tr>
<td>Non-recyclable plastics</td>
<td>146.50</td>
<td>26.54</td>
</tr>
<tr>
<td>(Food contaminated plastic)</td>
<td>(67.5)</td>
<td></td>
</tr>
<tr>
<td>(Other non recyclable plastic)</td>
<td>(79)</td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td>3.50</td>
<td>0.63</td>
</tr>
<tr>
<td>Kitchen paper &amp; tissues</td>
<td>49.50</td>
<td>8.97</td>
</tr>
<tr>
<td>Compostable food waste</td>
<td>99.50</td>
<td>18.03</td>
</tr>
<tr>
<td>Non-compostable food waste</td>
<td>90.50</td>
<td>16.39</td>
</tr>
<tr>
<td>Other non-recyclables</td>
<td>51.50</td>
<td>9.32</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>552</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
**APPENDIX XI:** Composition and weight of waste produced daily (8 wheelie bins of general waste & 5 wheelie bins of cardboard waste)

<table>
<thead>
<tr>
<th>Waste Stream</th>
<th>Weight (kg)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel cans</td>
<td>43.5</td>
<td>8.45</td>
</tr>
<tr>
<td>Aluminium cans</td>
<td>3</td>
<td>0.58</td>
</tr>
<tr>
<td>Recyclable plastics</td>
<td>25.50</td>
<td>4.96</td>
</tr>
<tr>
<td>Plastic pallets</td>
<td>2.50</td>
<td>0.49</td>
</tr>
<tr>
<td>Non-recyclable plastics</td>
<td>98</td>
<td>19.05</td>
</tr>
<tr>
<td>(Food contaminated plastic)</td>
<td>(45)</td>
<td></td>
</tr>
<tr>
<td>(Other non recyclable plastic)</td>
<td>(53)</td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td>2.50</td>
<td>0.49</td>
</tr>
<tr>
<td>Kitchen paper &amp; tissues</td>
<td>33</td>
<td>6.41</td>
</tr>
<tr>
<td>Compostable food waste</td>
<td>66.50</td>
<td>12.93</td>
</tr>
<tr>
<td>Non-compostable food waste</td>
<td>60.50</td>
<td>11.76</td>
</tr>
<tr>
<td>Other non-recyclables</td>
<td>34.50</td>
<td>6.70</td>
</tr>
<tr>
<td>Cardboard</td>
<td>145</td>
<td>28.18</td>
</tr>
</tbody>
</table>
| **Total**                             | **514.50**  | **100**