

# **FOOD WASTE IN AN AIRLINE CATERER'S PRODUCTION KITCHEN**

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## **Abstract**

Academic interest in the topic of food waste is building as a range of disciplines, including Dietetics and Foodservice Management, explore ways to reduce the amount of food unnecessarily sent to landfill. The social, economic and environmental costs of food waste are well documented. Perhaps most shockingly, many people face hunger and poverty every day, yet of the four billion metric tonnes of food produced worldwide, as much as 50% never reaches the consumer. In developed countries, most waste occurs in food retail outlets, consumer's homes, and in foodservices. Foodservices dispose of as much as 20% of the food they procure and therefore are a focal setting for food waste research. The majority of foodservice waste research has been on waste quantification and consumer plate waste. A foodservice sector whose waste has not yet been investigated is the airline catering industry, which globally produces more than 600 million meals each year. This is surprising, given industry dynamics and activities, provide an environment in which large quantities of food waste can occur. For example, tightly regulated food safety and quality, and catering to multiple airlines, each with their own menu and expectations. Additionally, there is variation between size, class, lengths of flights, and time of day as well as dietary requirements to cater for.

This study investigates the food waste in two centralised production kitchens of an in-flight service provider, focusing not only on how much is being wasted but where is it being wasted and why. A mixed methods approach was employed using waste audits, observations, document analyses and staff interviews. This allowed the quantification of wasted food and exploration of the drivers behind

waste generation. Data collection tools and analysis procedures were structured using a production processes and systems approach. Audit results revealed this case study kitchen produced more food waste than is typical in other foodservices. Fifty-seven percent of the total waste was found to be food waste, much of which came from raw or in-house cook product. The qualitative results found three major themes that contributed to food waste generation; (1) issues with menu development and forecasting, (2) staff attitudes and (3) staff behaviours. Reducing food waste has the potential to save significant food and labour costs and improve a company's social and environmental impacts. Recommendations for reducing or diverting food waste included creating an 'environmental champion' or waste management position, dedicating an ingredient room or 'mise en place' function, involving staff in a range of waste management strategies and managing airline menus to use food more efficiently. As well as being transferable to other airline caterers, it is envisioned many of these strategies could be applied to other large foodservice operations; in particular, those adopting 'Lean' principles and those operating in manufacturing style production. Further research could build on this study by determining the cost of wasted food and associated losses (e.g. labour), exploring airline and supplier attitudes to food waste in airline catering, and assessing the application of waste prevention strategies identified in this study.

## **Preface**

Dr. Miranda Miroso, from the Department of Food Science, and Dr. Heather Spence, from the Department of Human Nutrition, University of Otago, kindly provided joint academic supervision for this Master's project. The project concept was proposed by the academic supervisors and accepted by the Dietetic candidate.

The candidate was responsible for the following:

- Submission of ethical approval;
- Communication with case study contacts;
- Development of data collection tools;
- Recruitment of interview participants;
- Conducting waste audits, observations, document analyses and interviews;
- Transcribing verbal data;
- Development of analysis tools;
- Thematic analysis of data;
- Thesis writing.

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# Table of Contents

<b>Abstract</b> .....	<b>ii</b>
<b>Preface</b> .....	<b>iv</b>
<b>Acknowledgements</b> .....	<b>v</b>
<b>List of Figures</b> .....	<b>ix</b>
<b>2.0 Literature Review</b> .....	<b>3</b>
<b>2.1 Food Waste in Foodservices</b> .....	<b>4</b>
<b>2.2 Implications of Food Waste</b> .....	<b>4</b>
<b>2.3 Waste Analysis</b> .....	<b>7</b>
2.3.1 Qualitative Research in Waste Assessment.....	8
<b>2.4 Waste Management</b> .....	<b>9</b>
<b>2.5 Food Waste Attitudes and Behaviours</b> .....	<b>10</b>
<b>2.6 ‘Lean’ Principles and Foodservice</b> .....	<b>11</b>
<b>2.7 The Airline Catering Industry</b> .....	<b>13</b>
<b>2.8 Theoretical Frameworks</b> .....	<b>14</b>
2.8.1 Systems Model .....	14
2.8.2 Processes Framework .....	16
<b>2.9 Conclusion</b> .....	<b>17</b>
<b>3.0 Objective Statement</b> .....	<b>18</b>
<b>4.0 Methodology</b> .....	<b>19</b>
<b>4.1 Description of Sites</b> .....	<b>19</b>
<b>4.2 Research Design and Rationale</b> .....	<b>19</b>
<b>4.3 Data Collection</b> .....	<b>20</b>
4.3.1 Waste Audit .....	20
4.3.2 Observations.....	24
4.3.3 Document Analysis .....	26
4.3.4 Interviews.....	27
<b>4.4 Data Analysis</b> .....	<b>28</b>
4.4.1 Processes Framework .....	30
<b>5.0 Results</b> .....	<b>32</b>
<b>5.1 Waste audit</b> .....	<b>32</b>
<b>5.2 Processes framework</b> .....	<b>34</b>
5.2.1 Menu development .....	34
5.2.2 Forecasting system.....	35
5.2.3 Purchasing.....	37
5.2.4 Receiving/warehouse .....	39
5.2.5 Production.....	40
5.2.6 Assembly .....	42
5.2.7 Storage and Transport.....	44
5.2.8 External factors; airlines and supplier.....	44
5.2.9 Internal factors; quality assurance, HACCP .....	46
<b>5.3 Waste and environmental reports</b> .....	<b>47</b>
<b>5.4 Summary of Key Findings</b> .....	<b>47</b>
<b>6.0 Discussion</b> .....	<b>49</b>
<b>6.1 Menu development and forecasting</b> .....	<b>49</b>
<b>6.2 Attitudes of foodservice staff</b> .....	<b>51</b>
<b>6.3 Behaviours of foodservice staff</b> .....	<b>53</b>
<b>6.4 Conclusion</b> .....	<b>54</b>

<b>7.0 Application</b> .....	<b>56</b>
<b>7.1 Recommendations for food waste control</b> .....	<b>56</b>
7.1.1 Changing staff attitudes and behaviours .....	56
7.1.2 Managing a live forecasting system.....	59
7.1.3 Strategies to utilise excess food .....	59
7.1.4 Selling food waste management to a foodservice .....	61
<b>7.2 Application to Foodservice Dietetics</b> .....	<b>62</b>
<b>References</b> .....	<b>63</b>
<b>Appendices</b> .....	<b>66</b>
<b>Appendix A: Ethical Approval</b> .....	<b>66</b>
<b>Appendix B: Data Collection Tool; Bin Identification form</b> .....	<b>68</b>
<b>Appendix C: Food Waste Audit form</b> .....	<b>69</b>
<b>Appendix D: Recommendations for Sorting</b> .....	<b>70</b>
<b>Appendix E: Observation Protocol</b> .....	<b>71</b>
<b>Appendix F: Observation Checklist</b> .....	<b>72</b>
<b>Appendix G: Document Analysis Checklist</b> .....	<b>74</b>
<b>Appendix H: Interview Protocol and Question Guide</b> .....	<b>76</b>
<b>Appendix I: Information Sheet for Participants</b> .....	<b>79</b>
<b>Appendix J: Interview Consent form</b> .....	<b>81</b>

## List of Tables

*Table 1. Processes Framework and Foodservice Systems Model comparison.* \_\_\_\_\_ 31

*Table 2. Summary of Key Findings* \_\_\_\_\_ 48



## List of Figures

<i>Figure 1. The waste hierarchy for solid waste management</i>	9
<i>Figure 2. The systems model</i>	15
<i>Figure 3. The processes framework</i>	17
<i>Figure 4. Exhibit of food waste from a bin sorted into piles for weighing.</i>	22
<i>Figure 5. Example of Microsoft Office Excel 2011 spreadsheet used for data collation</i>	23
<i>Figure 6. Colour-coding and highlighting system</i>	29
<i>Figure 7. Example of transcribed and analysed interview</i>	30
<i>Figure 8. Percentage of food waste and non-food waste</i>	32
<i>Figure 9. Percentage of food items wasted based on preparation state</i>	33
<i>Figure 10. Percentage of wasted food items based on food categories</i>	33
<i>Figure 11. Exhibit from Site One, waste from daily fridge check</i>	38
<i>Figure 12. Exhibit of rubbish bag from production kitchen area</i>	40
<i>Figure 13. Exhibit of salad being disposed of due to overproduction at Site 2</i>	41

## 1.0 Introduction

It is estimated four billion metric tonnes of food is produced every year, yet 1.2-2 billion tonnes is never consumed, suggesting better utilisation of the food we are already producing is needed (1). An enormous amount of waste occurs early in the food supply chain (e.g. agriculture, processing) (1, 2), however in developed countries the most significant waste reductions may occur in food retailers, consumers' homes and in foodservices (3). The foodservice industry has the potential to contribute a great quantity of food waste, with estimates of one-fifth of the food that enters a foodservice ending up in the rubbish bin (4). Food waste research has been conducted in a number of settings including hospitals (5, 6), college dining facilities (7), restaurants, and school canteens (4). Little focus has so far been placed on the airline catering industry which globally produces more than 600 million meals each year (8). With an increasing population and more competitive air travel, this number is likely to grow. Research in the area of food waste has focused on quantifying the issue and investigating plate waste, with little examination of the drivers of food waste and the opportunities and barriers to waste reduction.

This study aims to add to the growing food waste literature by contributing extensive qualitative insight into the drivers for food waste in the under-researched industry of airline catering. Furthermore, it will provide an example of the potential amounts of food wasted in the production kitchens of in-flight service providers, information which is typically privately commissioned by companies. Lastly, it will provide recommendations for preventing food waste in this case study that may be applied to other foodservices.

The research will be presented as follows:

- **2.0 Literature Review** will assess the current literature available on food waste, waste in foodservices, implications of waste, waste management and analysis, attitudes and behaviours toward waste, 'Lean' practices, the airline catering industry, and the theoretical models contributing to this research;
- **3.0 Objective Statement** will provide the aims and objectives of this thesis;
- **4.0 Methodology** will describe the mixed methods approach used for data collection and the processes model used for analysis;
- **5.0 Results** will describe, in detail, the factors contributing to waste as identified in each phase of the processes framework;
- **6.0 Discussion** will elaborate on the present findings in relation to other available research, how the qualitative and quantitative findings interact and outline limitations of the study and scope for further research;
- **7.0 Application** will explain the proposed recommendations specific to the case study and why this study is applicable to the field of dietetics.

## 2.0 Literature Review

Food waste is an issue that is gaining global interest. An increasing world population raises the question: how are we going to feed everyone? Approximately four billion metric tonnes of food is produced every year, but 1.2-2 billion tonnes is never consumed (1). The results of investigation into the environmental impacts of food losses and food waste are staggering. The carbon footprint of global food losses and waste is the world's third highest CO<sup>2</sup> emitter, and nearly one-third of agricultural land is committed to the production of food that will not be consumed (2). There are associated impacts on biodiversity and climate change as well as economic and social costs (2). Food waste results from shortcomings in management practices, as well as political, societal and economic behaviours, which promote waste (1). The terms 'food waste' and 'food losses' are often used interchangeably in literature. 'Food waste' is reflective of loss at the consumer end of the food supply chain and is more likely related to behaviours (3). Therefore, for the present research, this is the more useful term.

This chapter will discuss food waste specific to foodservices (2.1), the implications of food waste (2.2), food waste analysis and management (2.3, 2.4), attitudes and behaviours toward food waste (2.5), the concept of Lean manufacturing in foodservice (2.6) and the airline catering industry setting (2.7). Lastly, the theoretical models underpinning this project are introduced (2.8).

## **2.1 Food Waste in Foodservices**

Waste and waste management has been studied in a variety of foodservice organisations, including hospitals, school canteens and university foodservices (4-7). Waste in foodservices can be classified into pre-consumer (production) waste and consumer (plate) waste. A Swedish study found 20% of food procured by foodservices was lost or wasted (4) with 4-10% of this being pre-consumer waste, an amount confirmed by other literature (9). Beretta et. al (10) estimated pre-consumer waste might be as much as 20%. Documented reasons for foodservice waste include; overproduction (4-6, 10), forecasting (5), staff attitudes and behaviours (5, 7) and plate waste (4-6).

It is well documented that a significant proportion of food waste in foodservice is consumer waste (4, 6). In developed countries, reducing consumer waste and waste in retail and foodservice sectors will have the biggest impact (3). For example, in the United Kingdom, food and beverage waste in foodservices and restaurants is estimated to be three million tonnes per year (11).

## **2.2 Implications of Food Waste**

When food is wasted, every resource that went into its production is also wasted. The closer to the consumer end of the food supply chain a food gets, the bigger the waste of energy and resources. Henningson et. al. (12) suggests minimising waste of raw materials can provide financial benefits for foodservices. However, some foodservice administrators perceived the cost of setting up a sustainable waste management system as a barrier (7). Whilst financial accountability is an obvious concern for businesses, Kwon et. al. (7)

noted the environmental impact of food waste as a motivator. Research in the airline industry shows management staff observe the link between being environmentally responsible and financial gains through 'eco-efficiencies' (cost savings resulting from decreasing waste). However, the benefits of social integrity may be less transparent (13).

Corporate, social and environmental responsibility implies voluntary commitment by a business to commit to social and environmental goals. Motivators, described by Lynes and Andrachuk (13), that contribute to the adoption of corporate social and environmental responsibility are, long-term financial strategy, eco-efficiencies, competitive advantage, good corporate citizenship, image enhancement, stakeholder pressures, and a desire to avoid or delay regulatory action. A number of enhancing or disabling 'catalysts' that affect a company's implementation were also identified. An example of an enhancing catalyst is internal leadership by way of an 'environmental champion' to advocate for positive environmental outcomes. This has been shown to influence a corporation's commitment to environmental responsibility. Commitment may be exhibited by development of policies, employee roles related to social and environmental performance, and publishing reports or external validation. Using these measures of performance as a feedback tool will assist in achieving continuous improvement (13).

The 'Triple Bottom Line', developed as an accounting framework, has gained popularity as a business model. It addresses profits, people and the planet ('3P's') as dimensions of performance instead of focusing purely on financial

performance (14). As a tool it can be used to promote sustainability within a company. Although the exact method for calculating Triple Bottom Line is debated, it uses measures from each dimension. For example, solid waste management and electricity consumption are environmental measures. The '3P's' as a company foundation for sustainability has seen great long-term profitability in the business sector and allows for a holistic evaluation of the organisation (14).

Unilever Food Solutions reported that consumer concern regarding the sustainability of food providers is growing (15). Sixty-six percent of participants deemed knowing how food waste is managed by a kitchen to be important (15). They also believe businesses or the government should be addressing the food waste issue. Kautto and Melanen (16) found pressure from customers was a primary reason for companies to improve waste management and environmental performance. The Institution of Mechanical Engineers recommends governments of developed countries to enforce policy to adjust consumer expectations (1). The Sixth Community Environment Action Programme provides strategies for the European Union to action, with the aim of meeting environmental objectives (17). One strategy is the 'Waste Thematic Strategy' which aims to achieve many objectives including reducing the overall volume of waste through prevention initiatives, utilising sustainable production and consumption patterns, and increasing resource efficiency (17). However, although participating countries have waste prevention policies, companies have focused on waste recovery and safe final disposal (16). Many

governments are also adopting a 'Good Samaritan' clause into legislation, which aims to protect companies who donate food in good faith (18).

### **2.3 Waste Analysis**

Waste management is an important accountability for foodservice operations. It is suggested foodservices should utilise an 'integrated solid waste management system' which adopts a variety of waste management practices (19). Conducting a waste analysis in a foodservice is important to gain better understanding of the present waste situation, identify where waste may be reduced, and providing a baseline to measure future waste reduction. There are many methods of waste assessment, from conducting observations through to in-depth 'waste stream analysis' where all daily waste is collected, sorted into categories (e.g. paper, plastic, food waste etc.) and weighed. While this method is very accurate it is also expensive and time consuming. Another method is a waste audit, where specific areas of the foodservice are investigated for waste types and amounts using random samples of waste over a long period of time (more than one week). This method requires less time and cost (19).

An example of a waste audit was in a large household waste study in the United Kingdom. This study used a food waste questionnaire and waste composition analysis to gain insight into the types and amounts of food waste (20). A standardised procedure was followed for waste composition analysis, which may be easily adapted, to analyse waste in a foodservice setting. Kerbside waste was collected and all bags were given an identification number. Waste material was weighed and then emptied onto a table for sorting. All non-food



waste was removed and weighed. Unpackaged food items were sorted into piles by food category, sub-category and preparation state, for example cooked potato in one pile and potato peel in another. Piles were then individually weighed and food information recorded. Food in packaging was removed from the packet with packaging and food weighed separately; the weights and food/packaging information were recorded (including expiry date).

### **2.3.1 Qualitative Research in Waste Assessment**

The majority of food waste research has focused on quantification (1, 2, 4, 10, 20) with less focus on determining the causes. Qualitative research provides insight that quantitative data alone overlooks. Comprehending 'process variables' (e.g. motivators for reducing food waste) is an important aspect of qualitative research as it draws attention to the causes of the outcome variables (e.g. was food wasted?) (21). Qualitative research has been shown to be useful for understanding complex issues such as food waste (5, 21) and customer satisfaction (22) in the foodservice industry. Techniques suggested by Arendt et. al. (21) for collecting qualitative data include observations, individual interviews and focus groups. There are also challenges to using these techniques that the researcher needs to be aware of, such as recruitment methods, diverse languages and researcher bias (21). Using both quantitative and qualitative research methods can provide rich data and greater understanding.

## 2.4 Waste Management

The waste hierarchy (Figure 1) depicts the preferred methods of waste disposal. This concept has been used to develop waste management strategies for many industries (23). At the peak of the hierarchy is waste minimisation or prevention. Benefits of focusing on waste prevention as a waste management strategy include reduced cost (through materials not purchased), reduced handling and wasted resources, reduced landfill costs and reduced environmental impact. However, as Price and Joseph (23) point out, interpretations of the waste hierarchy where 'waste minimisation' is at the top can focus on minimising disposal volumes. They suggest a solution is to prevent waste through efficient processes, and create less waste per unit of production.

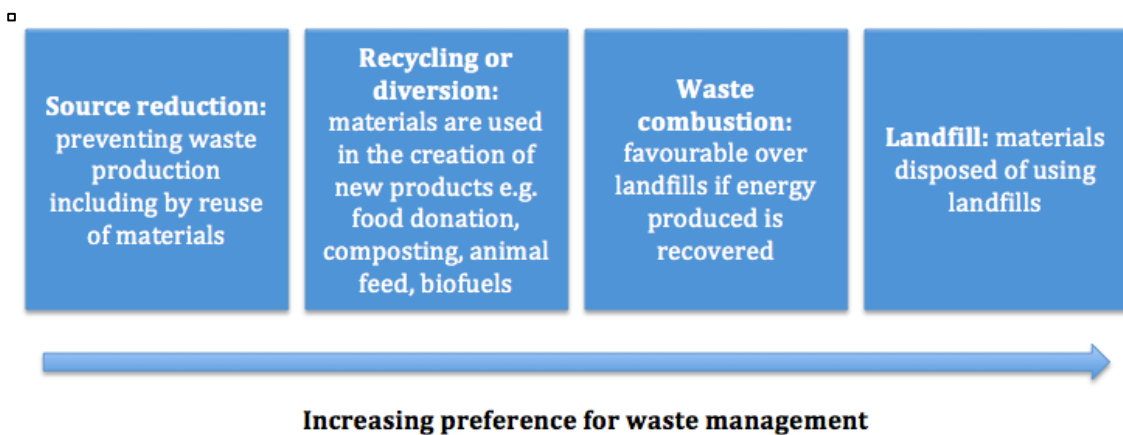


Figure 1. The waste hierarchy for solid waste management. Adapted from Payne-Palacio & Theis (19) (pg. 344)

Recycling and diverting waste are the next preferable use for waste. Recycling of plastics, for example, is commonplace in many countries. Diverting waste to composting and animal feed is becoming more common in the foodservices (24). While these methods are more acceptable than waste disposal through

landfills, Price and Joseph (23) suggest that a focus on 'waste minimisation' and recycling may promote a culture where waste is deemed acceptable.

## **2.5 Food Waste Attitudes and Behaviours**

In foodservices, the attitudes and behaviours of employees can have a large impact on food waste. When investigating food losses in foodservices Engström and Carlsson-Kanyama (4) found institutions were concerned about waste generated during handling procedures of production. One method used to overcome waste in handling procedures was for staff to share ideas for reducing waste. Engström and Carlsson-Kanyama (4) also noted a number of perceived barriers to preventing food waste, including time and the menu. When the kitchen environment becomes busy and stressful, staff may waste a food item instead of taking time reuse it elsewhere. A foodservice may also struggle to find ways of reusing over-produced food if the menu does not allow for it. Whitehair et. al. (25) investigated consumer attitudes to food waste in a university college dining hall. It was found that increasing awareness of food waste using illustrations and the target population's vested interests (in this case, the environmental impacts of food waste) promoted behaviour change. From these conclusions, it was suggested similar research could be applied to production personnel to achieve food waste reductions at a pre-consumer level.

Over-production is well referenced as a cause of food waste in the foodservice industry (3-5, 9, 10, 26). It is common practice for food manufacturers to produce more product than is needed to minimise the risk of not having enough if orders increase (3), therefore keeping the customer happy at the supplier's

expense. Cooking more than is needed is also observed in institutional foodservices (5) and was attributed to issues with forecasting and a variable consumer environment. Henningsson et. al. (12) suggest, to achieve waste prevention a foodservice needs to carefully audit, decrease waste from raw materials handling (over-production), and ensure adequate staff training.

Singapore Airlines is an example of an airline that has achieved cost-effective service excellence. Heracleous et. al. (27) describe two key factors in achieving this excellence: awareness of profit and cost for all employees, and continuous and holistic staff development. This concept is reinforced by research finding staff lack ownership of food waste issues faced by the whole foodservice (6). Peregrin (28) (pg. 1293) quotes Whitehair, “people are our most important tool in a successful sustainable operation”, and describes implementation of recycling in a foodservice. Management predicted the kitchen employees were likely to perceive completing extra tasks associated with recycling as overwhelming. When employees were involved in discussion around reasons for recycling and how it would affect their work tasks it achieved buy-in and they involved themselves in solutions for procedural changes to assist in recycling. Feedback to employees regarding the successes of the implemented recycling strategies helped positively reinforce their involvement and efforts (28).

## **2.6 ‘Lean’ Principles and Foodservice**

‘Lean Manufacturing’ (Lean) was developed as a method for creating greater efficiency in industrial manufacturing. Englund et. al. (26) (pg. 6) describes Womack & Jones’s summary of the five principles of Lean: (1) determine

perceived customer 'value' of the products, (2) "to identify and map the 'value stream' in the production line", (3) create a production line with continuous flow by connecting 'value-adding activities', (4) "not to produce anything 'upstream' unless it is needed 'downstream'" and (5) "pursuing perfection through continuous improvement" by involving all employees.

Originally used in automobile manufacturing, Lean has been adjusted to fit a number of other industries, including foodservice. The principles of Lean endeavour to decrease production costs and increase competitiveness through 'value-adding activities', which streamline production processes and reduce all types of waste (26). There are a number of benefits of practising Lean principles in a foodservice. In a case study where Lean was applied to a hospital kitchen, Engelund et. al. (26) found Lean reduced product waste and use of wasteful procedures through improving efficiencies in the production process. Product quality was improved as a result of systematic evaluation of quality and effective communication between management staff and production personnel. These advantages were achieved alongside the maintenance and improvement of a positive working environment. However, there are also limitations and barriers to Lean. One limitation, described by Cusumano (29), that is relevant to the airline catering industry, is product variety. It was observed the Japanese automobile industry developed a customer market with wide variety in product variations. This required more equipment changes and work during production for a larger number of small product orders. Reducing variety to focus on products that generate the most revenue and having

effective control systems and production schedules were suggested to resolve the issue.

## **2.7 The Airline Catering Industry**

The airline industry is one of high resource consumption. It has been argued that globalisation and liberalisation have caused an industry of “excessive air traffic growth and wasteful competition” (30) (page 275), the ramification of this being negative social and environmental impacts. The primary focus for sustainable behaviour has been on emissions (30), decreasing weight, being more fuel efficient, and (a small focus on) recycling (31). There has been little investigation into in-flight catering and waste.

It is estimated, globally, the airline catering industry produces 630 million meals a year (8). In an industry tightly regulated by food safety and quality measures, many issues may be faced when considering food waste reduction. In-flight providers often cater to a number of airlines each with their own menu and expectations, and within that, each flight is a different size. In addition, there is variation between classes, the lengths of flights, time of day as well as special or dietary requirements to cater for (8, 32).

“Flight catering is 80% logistics and 20% catering” (8) (pg. 55), because of the fluid yet strict environment of the airline industry in-flight providers face many issues. Loughlin (32) describes some of the issues faced by in-flight service providers including time constraints and menu variation. In-flight service orders may change up to 30 minutes before departure as last minute passengers

purchase tickets. It is an industry where food safety and quality are incredibly stringent, yet the environment needs to be dynamic enough to cope with last-minute changes and a wider variety of both food and non-food products.

Forecasting demand for products and services in the airline industry is particularly important. The tourism industry is a highly variable one and seasonality has a large impact on the airline industry with travel patterns being most unpredictable in the Australasian region (33). Johan and Jones (33) also emphasise the importance of forecasting for passenger by seat class as the meal options, quality and number of meals needed vary between classes. Forecasting passenger meals is a complex exercise as a number of factors influence whether a passenger will consume a meal, including the type of airline, seat class, and time of flight. Research conducted by the Travel Catering Research Centre found that caterers made little contribution to innovations in flight catering (34). Furthermore, there has been little focus on food as an area for new production development. However, innovations in logistics are more common.

## **2.8 Theoretical Frameworks**

### **2.8.1 Systems Model**

Foodservices are dynamic environments with many relationships between their internal and external environments. A systems approach to managing such an environment helps integrate the objectives of the organisation with all operations, and assists management functions such as decision-making and problem solving (35).

The foodservice systems model, described by Payne-Palacio & Theis (35) (pg. 48) is based on systems theory, where the organisation is viewed “as a whole made up of interdependent parts”. The model conceptualises this system idea and identifies interacting parts of the system. System ‘inputs’ (e.g. raw materials, money, people, information) are transformed by functional subsystems or ‘operations’ (e.g. purchasing, storage, production) into ‘outputs’ (e.g. finished product). The outputs need to align with the objectives of the foodservice and can be used to assess performance and provide ‘feedback’ for management to improve aspects of the system. Influencing all of these subsystems are the overarching umbrella components of ‘controls’ (e.g. contracts, regulations), ‘management’ (e.g. functions, decision-making) and ‘memory’ (records e.g. forecasting, financial). Influencing the whole system are external or ‘environmental factors’ including climate, customers, suppliers and competitors. The foodservice systems model is illustrated in Figure 2.

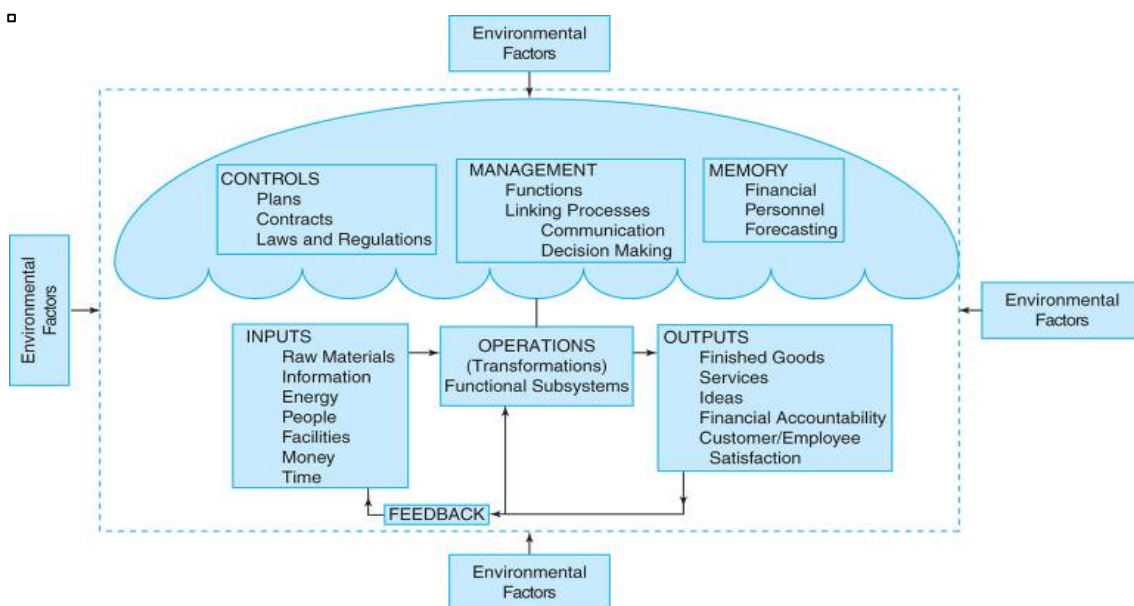


Figure 2. The systems model: From Payne-Palacio & Theis (35) (pg. 49)



Systems theory is a useful tool to organise information, assist with problem solving, planning and organisational development. Due to the highly integrated nature of the foodservice system it is recommended waste management solutions should take a systems approach. Considering the impacts of applying waste prevention methods to one area of the system may influence waste production in another (4).

### **2.8.2 Processes Framework**

As mentioned in 2.8.1, functional subsystems transform inputs to outputs (for example, raw potatoes to sautéed potatoes). While Payne-Palacio and Theis's (35) transformation subsystems depicted most of the processes in the production of the airline meals, some important steps were missing. Therefore, the 'transformation subsystems' were modified to include menu development, forecasting, and external factors being airlines and suppliers (Figure 3).

As with the foodservice systems model, the processes in this framework are all interactive meaning that an issue at one point in the framework may impact on other processes. It is also an open system and is influenced by external factors, the most significant being customers and suppliers.

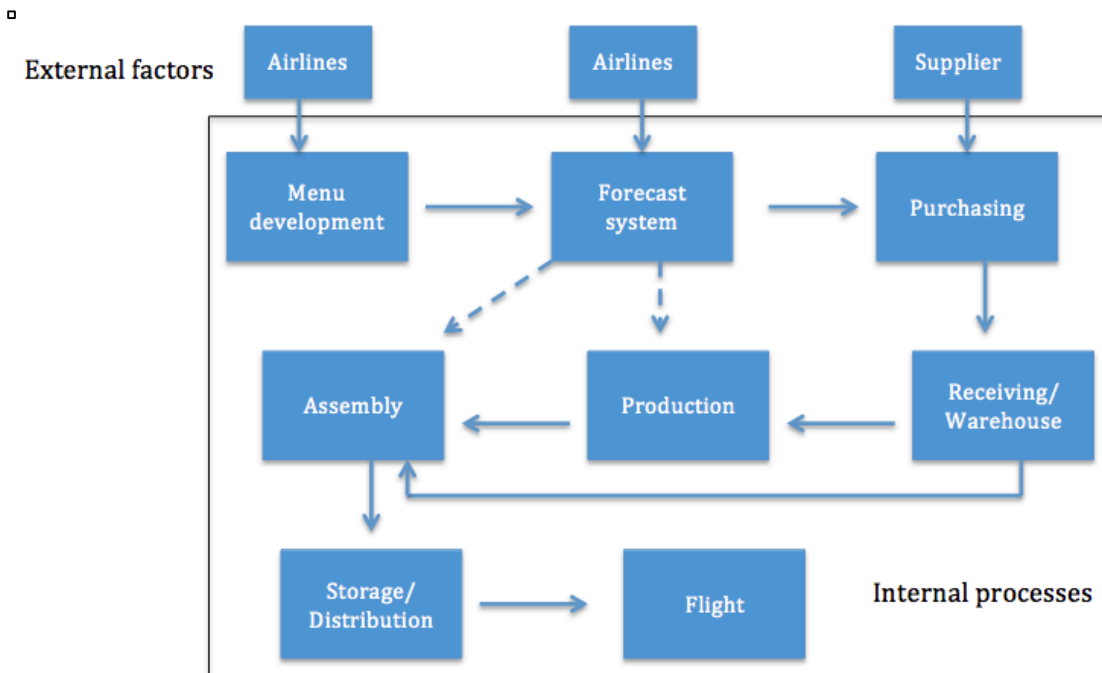


Figure 3. The processes framework developed to illustrate the processes in an airline-catering kitchen. Adapted from Payne-Palacio & Theis (35) (pg. 49)

## 2.9 Conclusion

Literature on food waste in foodservice is growing. Quantifying the waste has been the main focus in the literature to date but there is increasing recognition of the strengths of qualitative research to understand food waste-related attitudes and behaviours. The airline catering industry has had little publicly available research published and has the potential to collectively create a lot of food waste. In such a competitive industry, decreasing food waste will contribute to increasing profits and better performance in social and environmental responsibilities. The current study looks to quantify food waste in this area and investigate the possibilities of, and barriers to, food waste reduction through qualitative investigation. This will be achieved by applying the systems model and processes framework, developed specifically for the production processes of an airline-catering kitchen.

### **3.0 Objective Statement**

The current available literature in foodservices has little published on pre-consumer food waste. There is also a gap in the current literature providing qualitative insight to the issue of food waste in organisations. Furthermore, the airline catering industry is an area with minimal publicly available waste research. The present study aims to assess how much food is wasted in two production kitchens of an airline catering company, explore where and why the waste is being generated, and propose strategies to reduce the amount of food waste produced.

The research seeks to help answer the following questions:

1. How much production food waste is occurring in an in-flight provider kitchen?
2. Where in the system is the waste happening and why is it happening?
3. Of this waste, what is preventable and what recommendations can be made to prevent food waste? How can the waste that does occur be redirected?

## **4.0 Methodology**

### **4.1 Description of Sites**

The case study for this research was the food production operations of an in-flight service provider. The business is part of a larger global company producing in-flight food and providing in-flight utilities to airline customers for both domestic and international flights. Two company sites or units in different cities took part in the research; one large centralised production kitchen and one smaller centralised production kitchen. Both sites use a cook-chill production method (35).

“Site One” (the smaller kitchen) produces airline meals, food for a retail cafe and staff meals. It was estimated this site provides 10,000-14,000 airline meals per week, with 65 staff during the quiet season and additional temporary or casual staff hired during peak season. “Site Two” (the larger kitchen) produces airline meals, fresh sandwich and salad items for retail customers, and staff meals. It is estimated this site provides 70,000- 98,000 airline meals per week.

### **4.2 Research Design and Rationale**

Data collection was carried out in July 2014 over a three-week period; two weeks at Site One and one week at Site Two. Research was approved by the University of Otago Ethics Committee (Appendix A, D14-010)

Four data collection techniques were used in this research; waste audits, observations, interviews and document analyses. All these methods will be

discussed later in this chapter. Quantitative data was analysed to assess the volume of food waste. Two theoretical models were used to thematically analyse qualitative data. First, the foodservice systems model described by Payne-Palacio and Theis (35). Secondly, a framework was developed to reflect kitchen processes and provide a deeper analysis (Section 2.8.2).

To quantify food waste and determine why it is being created a mixed methods approach was imperative. Qualitative research is a useful research method in foodservices as it allows exploration of the reasons for a quantitative result. Understanding what Arendt et. al. (21) terms 'process variables' (motivators for the outcome variables) was an important aspect of the study and why a qualitative approach was incorporated into the study design.

### **4.3 Data Collection**

#### **4.3.1 Waste Audit**

Methods used and tools developed for the waste audit were based on resources and techniques employed by WRAP (20) (detailed in Section 2.3). This included a 'Bin ID form' (Appendix B), a 'Food Waste Audit form' (Appendix C) and 'Recommendations for Sorting' (Appendix D).

A designated area at each site was used for completing the waste audit. The space was away from all food preparation and close to the waste disposal compactor. Space included a large table, large scales, space for bag storage before sorting and movement around the area. Plastic sheets or large rubbish bags were used to cover the table. Before waste sorting started the area was

set up with clean table cover, small kitchen scales, gloves, and four-litre containers for weighing food waste. The researcher wore overalls or a dustcoat over warm clothing, disposable apron and arm sleeves, a hairnet and snood, gloves and covered-in shoes.

Staff in charge of waste collection and disposal removed waste from the kitchen areas and brought them to the waste sorting station. Wherever possible, the origin of the waste was determined; this was not always possible if staff did not know, or the researcher was absent when bags were delivered.

Three methods were used to collect waste data. Three were required because of the large amount of waste, the short time frame for data collection, and having only one waste sorter. The three methods used were:

1. All bags collected and food waste estimated: for this method 100% of the waste was intercepted from the kitchen, the bags were weighed, opened and the volume of food waste was visually estimated as a percentage of bag contents;
2. Sample of food waste: one or two bags from all areas of the kitchen were intercepted, these were weighed, the contents sorted and the food waste calculated;
3. All collected and food waste calculated: for this method 100% of waste was intercepted, the bags were weighed, the contents were sorted and the food waste calculated.

In all methods, recyclable, non-food waste was noted but not weighed or calculated.

A standardised procedure was followed for all food weighing. Waste arrived at the sorting station, each bag was given an ID number, the bag was weighed and the total weight recorded on the 'Bin ID form' (Appendix B) or audio recorded for later data entry. All non-food waste was removed and discarded. Remaining waste was sorted into piles (Figure 4). Using the 'Food Waste Audit form' (Appendix C) or audio recording; the bin/bag ID was recorded, a description of the food (e.g. cooked green beans), packaging information (if applicable) and best before/use by date (if available) were documented. If apparent, reason for disposal was also documented. Packaging was removed, weighed separately and the food/packaging weight recorded. When weighing and recording was complete all food waste was transferred into the waste compactor.



Figure 4. Exhibit of food waste from a bin sorted into piles for weighing.

Data from the forms and audio recordings was entered into a Microsoft Office Excel 2011 spreadsheet. Information entered included the bin ID, the date, area the waste came from, total waste (kg), non-food waste (kg), food waste (kg) and percentage of food waste. On a separate spreadsheet, information for each food item was entered. This included the bin ID, food item, weight, reason (if known), packaging, if packaging is opened, the best before date, the total food waste weight. Lastly, each food item was coded into one of thirteen food categories (Bakery, Meat/Fish, Dairy, Eggs, Dried foods/powders, Fruit, Vegetable, Confectionary/Snacks, Drinks, Condiments/sauces/herbs/spices, Desserts, Mixed foods and Other). Food items were also coded for preparation state (Fresh/Raw, Cooked in-house, Pre-prepared and Ready-to-eat) (Figure 5).

	A	B	C	D	E	F	G	I	J	K
1	Bin ID	Food item	Weight kg	Reason	Packaging	Opened?	BB	BIN total	Food by type	Preparation state
2	1	Kumara 10mm	6.000	BB		n	05.07.14		7	C
3		Broccoli florets	12.000	BB		n	04.07.14		7	C
4		Cauliflower florets	9.000	BB		n	04.07.14		7	C
5		Spring onion	0.756	BB		y	04.07.14		7	A
6		Red capsicum whole	1.265	BB		y	28.06.14		7	A
7		Green capsicum whole	1.000	BB		n	25.06.14		7	A
8		Yellow capsicum whole	1.382	BB		n	25.06.14		7	A
9		Red capsicum 20mm	4.384	BB		y	05.07.14		7	C
10		Red onion sliced	6.000	BB		n	05.07.14		7	C

Figure 5. Example of Microsoft Office Excel 2011 spreadsheet used for data collation

Information collected from the waste audit gave a clear picture of the weight of waste and where it was being created. While some reasons for waste were apparent (for example, it had reached its best before date), the waste audit alone did not reveal all reasons for waste generation. This is where the qualitative aspect of the study provided further insight. Qualitative investigations included observations, document analysis and interviews.



### **4.3.2 Observations**

Methods suggested by Sangasubana (36) were used to develop an observation protocol (Appendix E). These included a running description of what was being seen and heard, retrospectively recording 'forgotten episodes', noting ideas and thoughts for further investigations/questions and notes related to data collection methods.

It was initially planned to observe in large time blocks. However, to utilise time and minimise changes in staff behaviour, continuous observations were made, providing richer data. Observations were handwritten or audio-recorded in conjunction with all stages of data collection to increase exposure. The checklist developed to assist with observations was adapted from a waste analysis tool developed for use in large kitchens (37) (Appendix F). This was based on the foodservice system model.

A clipboard with blank paper, observation checklist (Appendix F), pen, highlighters and audio-recorder were always carried to collect as many observations as possible. Written observations were recorded on both blank paper and the observation checklist. As much detail as possible was noted about the situation being observed. Observational data included date, time, area of production and, if possible, staff present and what they were doing. Relevant comments from staff during observations were documented and identified by person and focus of the comment. Audio recordings required less information as the recording was automatically time and date stamped by the recording device. Any 'forgotten episodes' observations, or observations that

could not be recorded at the time, were noted retrospectively with the approximate time and details of the observation. Ideas or thoughts to be followed up further with management staff were noted. This was helpful in defining and restructuring interview questions. Any question or speculation unable to be answered by staff present were recorded and highlighted to follow up. Thoughts or notes related to the methods of data collection were also recorded. If applicable these were fed back to supervisors and considered for subsequent data collection and reflected upon for present data collection.

Six to seven hours were spent observing kitchen operations at the two sites. Observations were made in all areas of each site and across a range of times to get a complete overview of behaviours during hours of operation. This was important for understanding how the kitchen and the airline catering industry operate. Observing operations increased staff awareness of the researcher and initially influenced some behaviour. However, explanation of the research aims and hours the researcher was present allowed assimilation into the work environment to the extent that staff mostly returned to usual working behaviours.

Observations were useful for building an overall picture of how waste is being created but provided only limited information in answering the question of "Why?" Document analysis and interviews were therefore used to further explore reasons for waste generation.

### **4.3.3 Document Analysis**

The document analysis was carried out to identify and investigate any written documents or records, formal or informal that may relate to food waste. A list of documents likely to be found was developed. This included food safety programmes, policies and procedures, staff training resources, posters, menus, wastage records and formal reports.

The checklist developed to assist with document analyses was adapted from a waste analysis tool developed for use in large kitchens (37) based around the foodservice systems model (Appendix G). The document analysis was conducted over four to six hours, primarily at Site One, as company documents were consistent across sites. For larger documents, time was allocated to document analysis in a quiet area. However, as with observations, document analysis was also ongoing throughout the three-week data collection period. Document analysis notes made while carrying out other data collection were coded 'DA'. The final analysis included food safety documents, customer menus and specifications, production kitchen wastage records, staff training manual, special diet manual, boarding bill, examples of forecast reports, food safety/environmental policy posters, environmental report and a commissioned waste stream analysis of Site Two.

A number of documents expected to be analysed were unavailable, either because staff were unsure of where they could be located or there was no relevant document. Potential factors influencing food waste were identified through the document analysis and greater understanding of the foodservice

operations gained, particularly in relation to the impact of strict food safety codes on food waste. Staff interviews were conducted to gain further insight into drivers of wasteful behaviour, staff opinions and attitudes toward food waste.

#### **4.3.4 Interviews**

Semi-structured interviews were conducted with 19 staff members, eight at Site One and eleven at Site Two. Senior management, second-level management and catering staff were interviewed during working hours. Interviewees were selected both purposefully and from staff suggestions, from each department of the production chain and across the scope of staffing levels to provide broad and rich data. Participation was voluntary and consent was obtained before the interview.

Where possible, a specific space was established to conduct interviews. At Site One a spare office was utilised. At Site Two most interviews were conducted in managers' offices and a small number in the large staff cafeteria when there were few other staff present. At each interview the researcher had a pen, name badge, interview protocol and question guide (Appendix H) and the interview space was set up with audio-recorder, information sheet, consent form and appropriate seating. Staff were provided with the project information sheet (Appendix I) and consent form (Appendix J) as well as being told the aim and purpose of the project and how the interview would be conducted.

Once consent was gained the audio-recorder was turned on and the interview commenced. The interview was guided by fourteen pre-determined questions.

However, interviews developed naturally based on interviewee responses. The general line of questioning included what they thought about food waste created by the kitchen, where they thought the most waste was being created, what contributes to the food waste and who was/did they think should be responsible for managing the food waste? At the end of the interviews staff were thanked for contributing their time. Interviews ranged from 15 minutes to 1 hour and 15 minutes. All interviews were transcribed into Microsoft Office Word 2011 documents, providing 92 pages of interviews for analysis.

#### **4.4 Data Analysis**

When data collection was complete, quantitative waste data was transferred into a Microsoft Office Excel 2011 spreadsheet. The spreadsheet (Figure 5) was used to calculate results, which are depicted in graph form (section 5.0).

For qualitative data, all notes and audio recordings for observation and document analyses were compiled into Microsoft Office Word 2011 documents. Each interview was transcribed into a Microsoft Office Word 2011 document. Transcriptions were true to record except for mention of people names or the company, which is coded/blanked for privacy, and to comply with the company's confidentiality requirement. Time stamps were also noted throughout the transcript for future reference. The observations, document analyses and interviews were then analysed thematically (38) using the foodservice systems model (section 2.8.1) and the processes framework (section 2.8.2). First, a colour coding system was developed (Figure 6).

<u>Colour coding for FSM analysis</u>	<u>Highlighter coding for micro-processes analysis</u>
Environmental factors	Airlines
Controls	Menu development
Management	Forecast and yield system
Memory	Purchasing
Inputs	Suppliers
Operations/Transformations	Warehouse/receiving
Outputs	Production
Feedback	Assembly
	Storage/transport
	Flight

Figure 6. Colour-coding and highlighting system developed for thematic analysis of observations, document analysis and interviews.

Changing the colour of a section of ‘food waste related’ text was used to identify themes from a foodservice systems model perspective relating to each system. Different colours of highlighting were used to reflect the processes in the processes framework (Figure 7).

- 3: The HACCP program is the driver, it has everything, so what the HACCP says is what we do and there is no varying from that, it really the only factor.
- J: Are there any practices that you have observed or done yourself that you think increase or decrease the food being wasted?
- 3: **I have observed people not following the first in first out rule and that has a huge impact on what's being wasted.** Other than that there's maybe a little bit of over production at times from the kitchen. That's driven from figures and they fluctuate but apart from that no.
- J: With the first in first out rule, do you think it's something that can be worked on? Do you see it fluctuate with different chefs or times?
- 3: Not really, it's just something we need to keep on top of daily, and people do get lazy now and then and will just take what's handy. But everything is date displayed and so they should be and we do our best to label use first if it should be. (3:13)
- J: Whose responsibility is it to check that those things are happening?
- 3: **Receiving does the initial rotation of the food so it should come in and get stacked or put away correctly,** and then it's up to the people in the individual sections to ensure the rotation of the cook food would be hot pack, the chefs have a big role in what goes in and out of the hot packing fridge and then my role as well to check that it has been done correctly and then as well the quality person.
- J: Do you think the food waste is a big issue in the kitchen?
- 3: In the hot kitchen it's self or on the production floor?

Figure 7. Example of transcribed and analysed interview

#### 4.4.1 Processes Framework

The processes model consists of components of the functional subsystems from the foodservice systems model (section 2.8). The process chain begins with product development in the form of menus, a process in which the customer is heavily involved. The information for every meal and menu (similar to a bill of materials (39)) is incorporated into the forecasting system. The forecasting system receives live flight capacity information from each airline and is used to generate information for the purchasing, production and assembly processes, when it is required at each process. The purchasing process interacts with the external environment (the suppliers) to order raw materials, which enter the processes framework at the receiving process. Raw materials are either stored (warehouse) or enter straight into the production or assembly process. At the production process, raw ingredients are transformed into meal components according to recipes from the menu development. Completed meal

components are cooled, and then move into the assembly process where they are assembled based on specifications from the menu development process, providing the final product. This is then stored in a temperature-controlled environment until transport to the aircraft immediately before flight departure.

Table 1 illustrates the overlap between the foodservice systems model and the process framework, demonstrating why incorporating both models for data analysis was essential.

Table 1. Processes Framework and Foodservice Systems Model comparison.

<b>Processes framework (Figure 3)</b>	<b>Foodservice systems model (Figure 2)</b>
Menu development	Controls; plan Management; decision-making Information; input
Forecasting	Memory- forecasting
Purchasing	Transformation
Receiving/warehouse	Transformation
Production	Transformation
Assembly	Transformation
Storage/transport	Transformation
External influences; Airlines and suppliers	Output- customer satisfaction Environmental factors
Internal influences; Quality Assurance and HACCP	Control: programmes Feedback



## 5.0 Results

The following chapter describes the findings from the waste audit (5.1), observations, document analysis and interviews from sites one and two of the airline caterer. The qualitative results are reported based on the processes framework (5.2). A summary of key findings is presented in Table 2 (5.4)

### 5.1 Waste audit

Data collected from the waste audit was analysed to determine the amount of food waste, the types of food wasted and its preparation state. Two days of data collection were used to calculate the percentage of food waste. Estimated waste values and calculated values were both used, waste from all areas of the kitchen was included and samples were taken across the day. It was found that the average percentage of food waste was 57.3% of total waste (Figure 8). This is similar to the amount found by a private company commissioned for a full waste stream analysis (see 5.3).

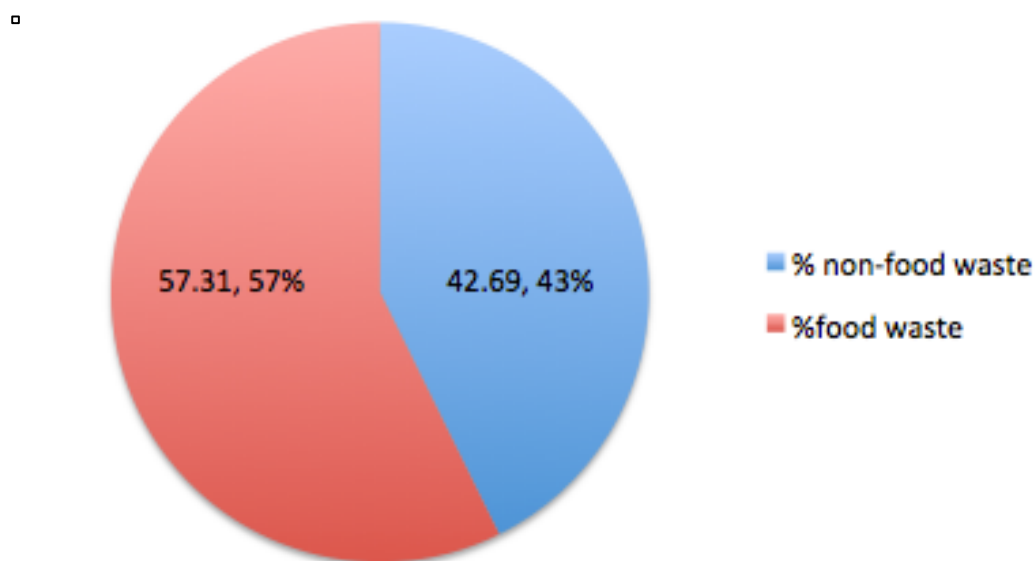


Figure 8. Percentage of food waste and non-food waste.



Figure 9. Percentage of food items wasted based on preparation state.

Vegetables (40.3%) were found to be the most wasted food type from the analysis of data at both sites. The meat and fish category contributed 11.9% of food waste, with condiments etc. contributing 10% (Figure 10).

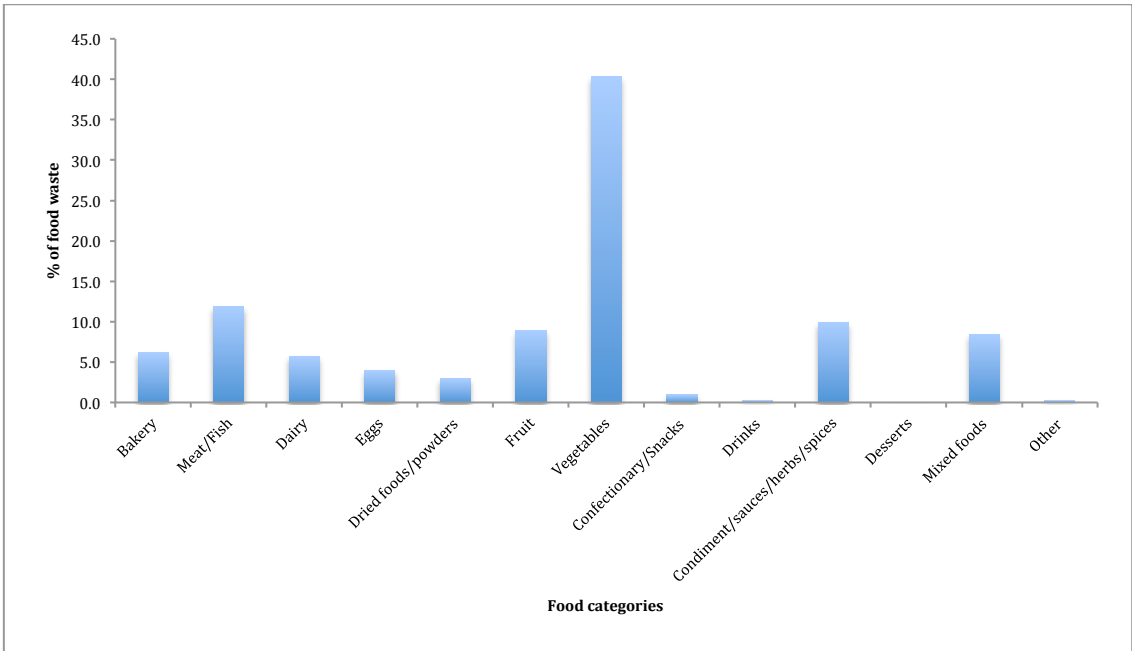


Figure 10. Percentage of wasted food items based on food categories

## **5.2 Processes framework**

### **5.2.1 Menu development**

The first step in the process chain is development of menus for each airline customer. Menus are based on negotiated specifications including portion size, presentation of individual meal components and price. Opportunities for waste arise from the wide range of menus required, the unique specifications for each menu item, portion sizes and presentation.

Menu development was identified as an area of the processes framework having a large impact on the food waste created. There is huge variety between and within customers' menus; therefore a specified food can often be used for only one dish. If this food is over-ordered, if the flight numbers are decreased, or if the flight is cancelled, excess food is wasted if it cannot be used in other meals or menus. As well as the variety between menus, there is a wide variety of portion sizes. For example one dish may have an 85g portion of beef and the next might have a 120g portion of chicken curry. Portion sizes may be negotiated to provide a meal at lower cost to the customer.

As part of menu development the meal specifications are negotiated with the customer. Different portion sizes are an example of this. Further meal specifications include cuts of vegetable. Two meals may have carrots with one being a 'baton' cut and the other being a 'flower' cut. If staff cook or assemble the wrong type of carrot for a dish, that food will be wasted and a replacement food prepared.

A challenging aspect of meal specification is that menu items may require a specified weight, portion size and regular, even shape. This results in waste of the food that does not meet these specifications. Fish is a common example of waste due to strict shape specification. Staff identified this as a source of waste. For example:

“When they are going to present the dish to the airline the airline will go oh nice, 3 piece, 35g beautiful, but in reality is that going to work?”...”because the fish is not square, so when they smoke the whole piece of fish, you are going to have smaller this side and this side so to meet that 35g 3 piece, you are not going to be using this part or this part”...“put 4 pieces on then QA are going to fail you, because you 4 pieces on and not 3, so then ok let’s put 3 pieces on and you find ok it doesn’t meet the weight” (Interview 9, page 4).

### **5.2.2 Forecasting system**

The forecasting system is a company-developed programme that uses information from menu development, with real-time passenger numbers from airlines, to provide a forecast for purchasing, production and assembly. With regular changes in menu cycles, meal specifications and product procurement, the forecast team is constantly updating the systems information.

If a calculated yield is wrong or there is a mistake in data entry, the information passed on to the processes further down the framework will also be incorrect. The forecast information is given to each process, as it is required. The system is updated when more seats are booked; therefore each process receives a

different forecast number to the preceding process in the framework. For example:

- Purchasing needs forecast data six to ten days before the flight;
- Production needs forecasts two to three days before the flight;
- Assembly needs' forecasts eight to twenty-four hours before the flight.

One staff member commented the assembly process was one and a half days behind the production “so there is already a gap” (Interview 9, page 2).

Some data/recipes/raw product that are developed for one site and are used at other sites may generate waste. Reasons cited were changes in yield from different ingredients (for example, different brands of canned tomatoes) and one site using an in-house produced or prepared item and the other a purchased item (Observations, page 4).

The above issues with the forecast system have lead staff to mistrust information provided to them. Understandably, if the numbers change after they have completed their transformation and product prepared doesn't meet what is required, they are responsible for preparing more product and get in trouble for there not being enough in the first place.

“...at the end of the day if you tell someone ‘you only do what the system tells you to do’ and then he gets in trouble by doing that because he doesn't make enough or it doesn't taste right” (Interview 14, page 4).

This has lead to a behaviour referred to as ‘buffering’ where staff at each step in the system are ordering, producing and assembling additional product to prevent the potential run out.

### **5.2.3 Purchasing**

Each site has a purchasing team responsible for ordering all products from suppliers. The staff involved with this process play a key role in the relationships with suppliers and communication of quality, date or delivery issues. Purchasing is based on information provided by the forecast system and at Site One there is close communication between the purchasing officer and kitchen staff.

Purchasing is the first step affected if there are incorrect figures from the forecasting system discussed above. This may cause over- or under-ordering. If food is under-ordered, more will need to be sourced at short notice and if the exact amount required does not match the purchase unit, the excess will be wasted if an adjustment is not made to the next order. Similarly, if an incorrect forecast results in too much food being ordered, excess will be wasted. The lead-time between purchasing of raw product and the confirmation of flight numbers can lead to purchasing teams having to estimate how much will be needed or purchase with the expectation of a full flight:

“We have a system that gives us all our airline figures, its not 100% accurate and we only put in actual flight figures 6 days out so if I’m ordering in advance more than that I’m basing it on full flight figures which sometimes isn’t the case.” (Interview 5, page 1)



Figure 11. Exhibit from Site One, waste from daily fridge check for stock that has 'expired' or will 'expire' in next 24 hours and not to be used.

Communication between purchasing, production and assembly staff is an important feedback method to prevent over- or under-purchasing. At Site One there was close communication between the production and assembly areas and the purchasing officer:

“...the chefs and the production team write out their wastage forms and they come to me and I go down the list and I can eliminate what I am ordering too much of”...“they let me know if there is too much of something or if something has gone wrong” (Interview 5, page 1).

It was not ascertained whether similar communication occurs at Site Two. At both sites wastage recording sheets are used; however, since they are used intermittently or not at all, they record only some of the waste.

#### **5.2.4 Receiving/warehouse**

This process is responsible for receiving and/or storing materials from suppliers. Materials are then distributed to production or assembly as required. All received goods are checked thoroughly to ensure they meet food safety and quality assurance criteria.

The 'first-in-first-out' rule is important for managing stock rotation and utilisation of prepared products. If newly received materials are not stored in a manner which makes the older stock more accessible it is unlikely to be used first. Large amounts of waste can be created by raw materials with a short shelf life if 'first-in-first-out' rule is not applied. The 'first-in-first-out' rule is part of staff induction and the food safety programme (Document Analysis, page 1), but there are also specific roles that are responsible for the rotation of stock as it arrives on site:

“Receiving [personnel] does the initial rotation of the food so it should come in and get stacked or put away correctly” (Interview 3, page 1).

The distribution of food to other production areas can cause waste. Particularly if the amount of a material being distributed is different from what is needed. A staff member provided an example: “I want 6.8kg of tomato, but your can size is 3kg each [2.2kg wasted]” (Interview 9, page 8). This supply method is also used for products from the freezer such as muffins. If only 50 units are needed but a whole box is supplied, product not used within the time frame from defrosting will be wasted.



### 5.2.5 Production

This process is primarily the cooking and chilling of meal components. A team of chefs and cooks prepare meal components based on information provided by the forecasting system and menu development.

The production process is also affected by any incorrect information from the forecast system. Any error in the recipes or yielding will trickle down and either cause over- or under-production. Lead-time is an issue for this process as well. The meal components need to be produced up to two days before the flight. The number of meals required often increase or decrease leading to a difference between what is produced and what is used by subsequent phases of the system. This causes staff to overproduce product to reduce the risk of run out later the process chain a behaviour referred to as 'buffering'.



Figure 12. Exhibit of rubbish bag from production kitchen area. Shows overproduction waste.

As with receiving/warehouse, if staff do not follow the ‘first-in-first-out’ rule materials will not be utilised within safe food time frame and be wasted:

“I have observed people not following the first-in-first-out rule and that has a huge impact on what’s being wasted” (Interview 3, page 1).

Non-compliance with the ‘first-in-first-out’ rule was anecdotally described as a lack of respect for materials that contributes to waste. This attitude is pervasive throughout all processes:

“...because it is company property they care about it less than if it would be their own” (Interview 14, page 6).

“...we have to educate, we have to give them a big enough reason to value what products they are holding as a value to the company and to them for the good of the business” (Interview 11, page 2).



Figure 13. Exhibit of salad being disposed of due to overproduction at Site 2.

Another attitude identified was a lack of cohesion between departments and management levels. One staff member described a lack of teamwork that is required to solve problems:

“The main things, work together like a team, you know, purchasing come together, sous chefs and exec chefs, all that management” (Interview 19, page 2).

This concept was reflected when a staff member stated that waste occurring in their department was not because of errors in their department but because of other departments (Interview 9, page 5).

Staff also expressed they would like something to be done with the food that is wasted such as donating it to charity (Interview 4, page 2). At Site Two, there has been management discussion regarding diverting organic waste to be composted or used for animal feed. One staff member raised concern that having such a system may promote waste:

“...we have to be careful that we don't promote 'ah its food waste we can recycle it' and its actually being created because of it” (Interview 12, page 5).

#### **5.2.6 Assembly**

This process assembles of all the meal components according to specifications to create the meal that goes to the customer. Cold meals or meal components such as hors d'oeuvres are assembled at this process under strict quality assurance and food safety control.

The effects of lead-time or any error in the recipes or yielding from the forecasting system flow through into the assembly process. For example:

“if a yield is incorrect the finished product we receive is only 65g and we have to meet 85g” (Interview 9, page 3).

This further exacerbates the lack of trust of information provided by the system, leading to ‘buffering’ behaviours. Lead-time has the greatest effect at this part of the process chain as it is under the tightest timeframe. This has led to overloading, an aspect of the ‘buffering’ behaviour unique to the assembly phase (witnessed at both sites but more predominantly at Site Two). Overloading is loading meals to full capacity regardless of the numbers forecasted, and although this happens for some flights only, it is a behaviour and attitude that may create significant waste. One staff member explained it: “whatever the pax number is we load it full” (Interview 9, page 6).

When the ‘first-in-first-out’ rule is not observed food that should be used first will not be utilised. Because of tight time frames for in-house products, if a meal component is not assembled within 36 hours of its production, the food safety plan defines it as unsafe for use and it is wasted. This was identified as an issue by staff:

“...a lot of our wastage depends on whether or not that person looks properly in the fridge. Sometimes instead of grabbing out the Thursday product they’ll touch the Friday product and start using it so then the Thursday will have to be chucked out” (Interview 4, page1).

### **5.2.7 Storage and Transport**

Once meals are assembled and loaded into flight carts they are stored in temperature-controlled rooms until transport to the plane before the flight. There is little opportunity for waste at this process unless product is mishandled, or stored incorrectly making it unsafe for use and therefore wasted. However, this was not observed or a concern expressed by staff.

### **5.2.8 External factors; airlines and supplier**

The customer environment of the airline catering industry is one where the customer has a huge amount of power in the relationship:

“...you are completely exposed to your customers, they can walk in anytime, walk around any item and their purpose here is to find fault”  
(Interview 11, page 3).

Flight delays, cancelled flights and decreases/increases in flight numbers all are part of the industry but have a big effect on waste. Some staff have a more holistic view of who should be responsible for the waste being created by in-flight services:

“...we should put more pressure on the airlines to reduce the amount that we are throwing away because it is a cost to us, I don't think we measure that very well, you know, as in how much is being off-loaded and how much we need to throw away” (Interview 10, page 4).

Waste may also be impacted by behaviours of the supplier. For example if a supplier attempts to send product with a short expiry date it can be hard for the company to use that food in time:

“...if our suppliers can sneak in the products with short expiry dates, um, it makes it quite hard and tight for us to turn them over as well” (Interview 1, page 2).

There is policy for managing this where the product is identified, ‘rejected’, sent back to the supplier and replaced, however this relies on all staff being aware of the situation and feeling comfortable to identify the issue to supervisors or managers.

An issue mentioned in preceding processes is a product being supplied at a weight not equivalent what is needed. An example provided by a staff member is if the forecast system calculates that 21.08kg of sirloin is required and the purchase unit is 25kg, there is an oversupply of 4kg. The extra 4kg is likely to be cooked, assembled as spare meals, or not assembled and wasted (Interview 9, page 8). It would be ideal if suppliers would supply materials according to menu specifications. However, a senior staff member identified that the result of so much variation between and within menus, having so many different cuts and of different weights is likely to be an expensive practice. The more specific a product is, the more the cost and likelihood of product being unavailable is increased (Interview 14, page 3).

### **5.2.9 Internal factors; quality assurance, HACCP**

The airline catering industry requires very strict food safety programmes. This means that 'best before' dates are treated as expiry dates and fresh produce is often wasted. It was mentioned by staff that once a product has reached its 'best before' date, its safety and quality couldn't be guaranteed, so it is not used (Observations, page 1).

Any product produced 'in-house' has limited time for each 'sub-set' or step in the process. Cooking and assembly is one sub-set, and assembly to scheduled time of departure is another. For cold product each sub-set has 24 hours or a maximum of 48 hours. For hot product each sub-set has 36 hours or a maximum of 72 hours (Document Analysis, page 1). If food is not utilised properly, for example, the 'first-in-first-out' rule not being adhered to or if there are flight delays or changes, food not used within the timeframe is wasted.

Strict food safety and customer requirements require strong quality assurance involvement at all processes in the framework. However, any defects in product such as if products aren't prepared/assembled to specifications, or if products aren't date-labelled in the fridge, quality assurance staff may throw them out:

“...if it hasn't got a date sticker on it's gone. Which I mean is fair enough, everyone knows now to put a date sticker on as soon as they've done it, but there is a lot of stuff that, there, that, she tends to throw out that will last for a month.” (Interview 7, page 3).

“...if you open it you take it out, whatever you are going to do, don’t put it back otherwise it becomes a quality issue which is high risk, which is much more important than the wastage” (Interview 9, page 6).

### **5.3 Waste and environmental reports**

Analysis of documents identified two reports relevant to waste production in this company. A waste stream analysis commissioned in 2013 showed that 52.4% of total waste was organic, with the largest contributor of this being vegetables (Document Analysis, page 2). The second, a global sustainability report for the company published in 2012, focused on in-flight services and the catering sector in the airline industry. Whilst in-flight service providers were reported to be developing clearly defined and achievable environmental goals, the report’s focus was weight reduction innovations to decrease fuel consumption. The importance of an effective forecasting and materials’ planning system in meeting the customer demand was emphasised again in relation to reducing on board weight and wastage (Document Analysis, page 2).

### **5.4 Summary of Key Findings**

Table 2 summarises and categorises the key themes of results. Three major themes were identified; issues with menu development and forecasting, attitudes of foodservice staff and behaviours of foodservice staff. The major themes are used to categorise subthemes identified.



Table 2. Summary of Key Findings

<b>Major Themes</b>	<b>Subthemes</b>	<b>Process affected</b>
Issues with menu development and forecasting	Large variety between and within customers' menus	Menu development, Airlines
	Large variety of portion sizes	Menu development, Airlines
	Specifications; shape	Menu development, Airlines, Production
	Specification; weight, portion and size	Menu development, Airlines, Production, Assembly
	Input error or yield error in forecast system	Forecast system
Attitudes	Time lapse between different processes	Forecast system, Purchasing, Receiving, Production, Assembly
	Lack of trust of information provided by the forecast system	Menu development, Forecast system, Production, Assembly
	Staff not following company policies ('first-in-first-out' rule)	Production, Assembly
	Lack of respect for food materials	Purchasing, Receiving, Production, Assembly
Behaviours: "The buffering effect"	Lack of teamwork/sense of whole company responsibility	All aspects of processes framework
	Resistance to provide/record waste information	Purchasing, Production, Assembly
	Over-ordering	Purchasing
	Over-production	Production
	Over-loading	Assembly

## **6.0 Discussion**

This case study has shown how food waste generation is influenced by a number of interrelated factors including menu design, forecasting, and overprovision, resulting largely from staff attitudes and behaviours. It has also suggested that production food waste in this foodservice may be more than in other foodservices (10). The following chapter elaborates on the key results identified in Table 2, discussing each in relation to available literature (overviewed in Chapter 2).

### **6.1 Menu development and forecasting**

Menu development and the forecasting system are crucial initial steps in the processes framework around which operations are based. Any process with the potential to generate waste can trickle down to impact the whole system. The subthemes discussed which contribute to waste generation include wide variations between menus, ingredients and specifications, and managing a live forecasting system.

Results identified wide variation in menus, ingredients and meal specifications. The waste this variation is contributing is reflected in Figure 9, showing raw food and in-house cooked food as the largest contributors. This suggests that over-ordered or overproduced food has limited opportunity to be re-used. The ability to negotiate a more standardised meal range between airline customers is unlikely for business class, as this is where customers differentiate themselves. However, in economy class this is a viable option and would provide opportunity to utilise products that would otherwise be wasted. In industries of mass

production, as in airline catering, a customer market with abundant variation may increase waste. Reducing the amount of variation in areas that create the most revenue can help decrease production waste (29).

Difficulties forecasting is an issue that can contribute to food waste in a foodservice (5). In airline catering this is particularly difficult yet monumentally important (33). Using a live forecasting system coupled with regular menu changes requires raw information going into the forecasting system (e.g. recipes, specifications etc.) to be constantly updated. This also provides increased opportunities for data input errors to be made. Utilising an ongoing system to identify over- or under-production and manage new system information whilst maintaining accuracy of food requirements will be crucial. A method for controlling the live and dynamic updating system that employees can trust is needed. Currently the Site Two is working on both of these issues. Only some staff in some kitchen areas use the present wastage system. Site One is using the system to provide feedback to the purchasing department to manage over-ordering, but not in production or assembly areas. At Site Two, while its usage was reported, no current records were available.

Results from the present study are similar to the waste analysis commissioned by the company. It found 52.4% of total waste was organic and vegetables contributed to this waste most. This research found a slightly higher percentage of total food waste of 57.3%, but also found vegetables to be the highest contributor to this waste. While these two audits were conducted at different

times of year and used different methods, it may still be concluded there has been no improvement in the food waste management since 2012.

## **6.2 Attitudes of foodservice staff**

Staff attitudes and perceptions impact the waste generated by a foodservice (5, 7) and may develop for a number of reasons. In this study the main contributors to staff attitudes that created waste were; a lack of trust in the forecasting system, perception of inadequate time to complete tasks and comply with policies, and a lack of cohesion between departments and staffing levels.

The issues created by the forecast system, (discussed in 6.1), have created mistrust in provided information among staff members. Floor staff were resistant to participate in solutions such as recording waste information, and management had mixed opinions of how useful solutions would be. As the issue has been ongoing, staff attitudes tended to be negative.

Another key influence on staff attitudes is the Lean labour focus of the company. Allocated hours are sufficient only to prepare the number of meals required, with no allowance for correcting errors or changes in a highly variable environment. Perceived time constraints were identified by Engström and Carlsson-Kanyama (4) as a barrier to preventing food waste in other foodservices. Furthermore, in this study, this led to a perception amongst staff that it is acceptable to take short cuts, such as ignoring the 'first-in-first-out' rule, and provides perceived barriers to carrying out tasks such as recording waste.

This may influence staff members to misuse materials (e.g. wasting food unnecessarily, eating food) due to feeling over-worked and under-appreciated.

When applying Lean manufacturing concepts to a foodservice it is important to maintain a positive working environment (26). Management staff demonstrating best practice is critical to such an environment. When management staff attitudes towards waste are not positive, other staff take on those attitudes. As discussed by Engelund et al. (26) a working environment should be focused on joint responsibility, team work, and having staff at all levels involved and invested in improving processes that affect waste generation. This was not witnessed in this foodservice. Moreover, while the company professes to practise Lean, staff are not included in the systematic evaluation of processes as suggested by Engelund et. al. (26). Other authors proclaim the importance of staff involvement in problem solving (28) and adequate, holistic staff training in achieving excellence (27) and preventing waste (12).

The discussed working environment is one where wasteful attitudes are able to thrive. Furthermore, labour constraints and a constant push-pull between higher management demand and floor staff abilities create a sense of lack of cohesion. There is a lot of diffusion of blame and responsibility onto other departments because of the multiple opportunities for waste and error at each process. In the current study, this is especially dominant at the larger kitchen, (Site Two) where some managers were observed or reported dismissing their department's responsibility for food waste (for example, blaming another department). This attitude disseminates to floor staff who mimic these attitudes or reflect them in

their behaviours. Sonnino and McWilliam (6) also noted staff lacked ownership of food waste issues faced by the whole foodservice, an attitude identified in this research as well.

### **6.3 Behaviours of foodservice staff**

The environment created by huge variation, limited labour time, strict food safety, and a constantly updating forecasting system has created attitudes that encourage wasteful behaviour. To save time, and reduce the risk of running out of product if flight numbers increase, staff behaviour throughout the production processes is to 'buffer'. This means over-ordering, overproduction and over-assembly with excess food being wasted or loaded onto the plane to be disposed of at a different location. If leftover food is not assembled it may be used for a future flight, within the food safety requirements. In manufacturing, it is common to produce more than is needed as a buffer against possible run out (3). As airline catering has many features of a manufacturing foodservice it was not surprising to find the behaviour in the organisation. Over-provision is a common theme in food waste literature and throughout the food supply chain. In the present study, it was noted to affect almost every aspect of the foodservice. Over-ordering occurring at purchasing, overproduction in the production area and over-portioning and overloading in the assembly area. Furthermore, 'buffering' behaviours at the assembly level are contradictory to the focus of the sustainability report, which emphasised reducing unnecessary weight as an important strategy to decrease fuel consumption, emissions and wastage.

A key aspect of Lean manufacturing described by Engelund et al. (26) is to negate items upstream that aren't going to be utilised downstream. This relies on a streamlined production approach, contradictory to current 'buffering' behaviours practised across departments by staff of the foodservice. At present, this airline foodservice is partially operating in a "just-in-time" manner, but because of the complexities in menus, changing flight numbers, and lead-time between production processes, this process lacks efficiency. The last section of the process framework operates "just-in-time" (at assembly and transport) but the ordering and production processes have longer time lapses. Changing the production schedule may help (29), and this strategy is being developed by production management.

While waste prevention is the primary aim, there will always be an amount of waste that cannot be prevented. Utilising waste diversion methods such as composting, animal feed and food donations are useful for minimising the amount of organic waste going to landfill. Staff showed support for donating food to charity, an act that will hold less risk when legislation in New Zealand is update. The new 'Food Bill' will include a 'Good Samaritan' clause to protect companies who donate food in good faith from liability (18).

#### **6.4 Conclusion**

The above discussion is specific to the unique environment of this case study. There is little publicly available research in airline catering, especially on the topic of waste, due to the highly competitive nature of the industry. This study contributes to the growing pool of quantitative food waste data available for

foodservices, and provides a deep qualitative exploration of the causes. Menu design, issues in forecasting, and staff attitudes and behaviours were identified as drivers of food waste, and were discussed. The applications suggested in Chapter Seven have a logistics and system-wide focus to preventing food waste, as the logistics of airline catering are what make it such a complex foodservice. The findings may be applicable to other large foodservices especially those using 'Lean' practices or operating mass production or food manufacturing.

While this study has made significant contributions to the scarce research available for airline catering, specifically related to production food waste, there are limitations that need to be disclosed. In this highly variable industry, seasonality may have a significant effect on food waste and as data was collected over a three-week period during 'off-peak' season, waste may be more or less than at other periods of the year. Although the drivers of food waste were thoroughly investigated, there was no financial analysis carried out to quantify the impact of food waste in economic terms and this should be investigated further. Lastly, the present research obtained only the views and opinions of the airline caterers and not their suppliers or customers. Therefore, there is opportunity to build on this research, including; full-year or between-season research investigating waste quantities and causes, financial analysis of waste including labour, equipment and food losses, investigation and comparison of avoidable and unavoidable food waste, gaining the perspective of airlines, suppliers and consumers, assessing the implementation of suggested applications, and measuring ongoing progress and waste reductions.



## **7.0 Application**

This chapter outlines recommendations to management of the case study business (7.1), and discusses how the findings may be applied to other foodservice settings and wider dietetic practice (7.2).

### **7.1 Recommendations for food waste control**

Management identified some food waste issues, especially those related to the forecasting and menu development. However, it is important to consider food waste as a dynamic, system-wide issue that needs to be managed and coordinated throughout the business. Whilst it is important to address root causes of waste (such as the forecasting system and menu development), it is equally or more important to resolve the attitudes and wasteful behaviours that are ingrained in staff.

#### **7.1.1 Changing staff attitudes and behaviours**

A strong commitment to food waste management throughout departments and staffing levels will be important for changing staff attitudes and behaviours. Food waste management will need to be an on-going priority for all staff.

It is recommended a management position be created for an “environmental” champion. This individual’s priority would be to:

- Employ, manage and maintain food waste reduction strategies;
- Ensure company policies and procedures are in place and are followed by all departments;

- Investigate further waste in the foodservice including wasted resources such as water or gas and recycling;
- Perform a financial analysis with assistance from accounting staff to ascertain the financial impacts of food waste, to be used as a measure of food waste reduction success.

Support and involvement from higher management and all departments would be necessary for the position to be successful. A cost analysis may need to be carried out initially to determine if food and labour costs saved through waste reduction would fund this position.

Involving floor staff in identifying and solving food waste issues would help increase staff buy-in and promote a sense of responsibility and pride in their role in the company. Practical ways to achieve this would be to:

- Record staff ideas and suggestions for improvements on a whiteboard;
- Include food waste on the agenda of regular meetings;
- Emphasise teamwork and joint responsibility between departments;
- Ensure communication between managers and staff is effective;
- Share issues and solutions between management to assist each other in reducing food waste.

It is an essential component of a company's social responsibility to create a positive work environment. This could be achieved by maximising staff involvement in food waste management (26).

Another staff behaviour that needs to be addressed is non-compliance of the 'first-in-first-out' rule. To assure consistent compliance, the company should:

- Provide extra staff training regarding this rule;
- Emphasise, in training, the importance both in food waste reduction and food safety.

Some barriers to following the first-in-first-out rule identified by staff included lack of time and lack of knowledge (particularly in temporary staff). In addition to further staff training, it is recommended the company establish procedures related to fridge organisation for cooked menu items which all departments follow. For example, stacking newly cooked food behind previously cooked batches would help the correct food to be used first.

A 'mise en place' position would be valuable investment for the foodservice. It would be pivotal that this employee understand the importance of the role in food waste management and be willing to act as a 'food waste reduction champion' for kitchen staff. The key roles of this position would be:

- Organisation of raw ingredients for the production team. This implies having ingredients for meal components pre-weighed and labelled to save production staff time and prevent opportunities for errors, such as taking new stock first or taking more than is required;
- Communication between production and purchasing to help identify foods that are consistently over-ordered or under-ordered;
- Management of the stock available to the productions kitchens. This implies ensuring produce is correctly rotated and production staff are aware of food that is nearing use-by dates, and increasing opportunity for it to be utilised, if not for in-flight meals, then in the staff cafe.

### **7.1.2 Managing a live forecasting system**

The company has already identified the live forecast system and excessive menu variations as issues. Some ideas for solving these were being discussed and actioned by management during the data collection period. It is recommended that more emphasis be placed on using the current wastage reporting, especially in the production and assembly areas.

The wastage report will be an important accountability tool for identifying overproduction and over-assembly, which can be traced back to identify the cause (for example, an error in the menu). For wastage reporting to be successful, all departments and both management and floor staff will need to be on-board and involved.

### **7.1.3 Strategies to utilise excess food**

Strategies are required to manage over-ordered and over-produced food. One way to achieve this would be to create more standardisation between customer menus, especially for economy meals which make up the majority of meals produced. More standardisation between menus would give more opportunities for over-produced or over-ordered food to be utilised, decreasing the amount of food wasted.

This could be done through an economy meal catalogue, a concept that is used by other airline catering companies and was identified during data collection. The economy catalogue would need to be well marketed to customers and a non-negotiable but competitive price offered to help gain customer buy-in.

Creating more overlap between customer menus would make production more efficient. It would be easier to streamline production processes for example, by producing similar meal components that belong to different menus at the same time (26).

It is anticipated the food cost savings made by employing strategies to decrease food waste will balance some of the difference in offering lower cost meals. Further aspects of the menu could be used to help offset the difference further, including:

- Have a menu featuring seasonal vegetables that are lower cost;
- Limit the specifications available, for example, for shape and size. Offering only two to three cuts of carrot would decrease variety in ordering and increase opportunities for use if over-ordered or overproduced;
- More lenient specifications for shape and size of protein portions such as fish, would help utilise fish fillets completely;
- Feature meals which utilise the protein offcuts of other meals or business class meals;
- The use of standardised weights for protein components (such as curries) to create efficiency in meal assembly and decrease tools required.

The above strategies could be used independent of an economy meal catalogue to reduce waste, reduce food cost and create efficiencies.

#### **7.1.4 Selling food waste management to a foodservice**

All recommendations need to be sold to the company using the Triple Bottom Line approach. It is for this reason that all recommendations have been considered on an economic, social and environmental basis.

The biggest driver for decreasing food waste was identified by staff as achieving eco-efficiencies by decreasing financial losses or increasing financial gains. Reducing food waste will help decrease food costs, and create greater efficiencies in production and assembly. The decision to add staffing positions would need to be considered financially but the efficiencies created and food and labour waste minimised would reduce the gap between money spent and money saved. This cost benefit would need to be quantified (refer to first recommendation in 7.1.1).

The environmental and social aspects were also identified as concerns by staff. It is recommended the company review its commitment to corporate social and environmental responsibility (13). There are established environmental key performance indicators (KPI). These need to be revisited and regularly reviewed to ensure progress. Investigating ways to redirect unpreventable food waste such as by composting would align with environmental KPI and has already been considered by the company as a possibility in the future. Another use for food waste is to donate food to charity. With many individuals living in 'first world poverty' there is a stronger emphasis on the role of large companies and corporations to be more socially responsible with food waste.

Furthermore, it can be anticipated that a change in accountabilities placed on large-scale foodservice is inevitable. Many countries in Europe already have incentives and penalties for excess waste generation and resource consumption (17). If a company has already made such changes ahead of them becoming mandatory, there will be a period of time where they have a competitive advantage in the market by operating more efficiently than their competitors and in doing so, create a more successful brand.

## **7.2 Application to Foodservice Dietetics**

As aforementioned (6.5), recommendations may be transferrable to other foodservices and would be most useful to larger organisations, those implementing 'Lean' strategies, or those with a mass production or manufacturing operation. All foodservices should be seeking to reduce the amount of food waste they create as part of being financially accountable and socially and environmentally responsible. Beyond application to foodservices, dietitians play an important role in advocating for sustainable practice in both foodservices and wider organisations. As more individuals become aware of the need to live in an environmentally responsible fashion, dietitians are in a position to provide information and support for achieving sustainable and healthy nutrition goals. For these reasons, the Academy for Nutrition and Dietetics encourages dieticians in all fields of practice to pursue continuing competencies in sustainable, resilient, healthy food and water systems (40). Reducing food waste can play an important part in this lofty challenge.

## References

1. Fox T, Fimeche C. Global food: waste not, want not. London (UK). Institute of Mechanical Engineers; 2013 Jan.
2. Food and Agriculture Organisation of the United Nations. Food wastage footprint: impacts on natural resources- Summary report. Department NRMaE; 2013.
3. Parfitt J., Barthel M., Macnaughton S. Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical Transactions: Biological Sciences*. 2010;365(1554):3065-81.
4. Engström R. & Carlsson-Kanyama A. Food losses in food service institutions Examples from Sweden. *Food Policy*. 2004;29(3):203-13.
5. Goonan SL. Getting a taste for food waste; an ethnographic exploration into the generation of hospital food waste prior to patient consumption.[Master's Thesis]. Dunedin, New Zealand: University of Otago; 2012.
6. Sonnino R., McWilliam S. Food waste, catering practices and public procurement: A case study of hospital food systems in Wales. *Food Policy*. 2011;36(6):823-9.
7. Kwon S., Bednar., C., Kwon J., Butler, K. . An Investigation of College and University Foodservice Administrators' Level of Agreement on Potential Influencing Factor on Sustainable Food Waste Management *Journal of Foodservice Management and Education*. 2012;6(2):21-6.
8. Yi-Chi Chang Y., Jones P. Flight Catering: An Investigation of the Adoption of Mass Customisation *Journal of Hospitality and Tourism Management* 2007;14(1):47-56.
9. Shakman A. Redefining Foodservice Waste Management: What's Next. *Foodservice Equipment & Supplies*. 2009;62(13)
10. Beretta C., Stoessel F., Baier U., Hellweg S. Quantifying food losses and the potential for reduction in Switzerland. *Waste Management*. 2013;33(3):764-73.
11. Waste arising in the supply of food and drink to households in the UK. WRAP. 2009.
12. Henningsson S., Hyde K., Smith A., Campbell M. The value of resource efficiency in the food industry: a waste minimisation project in East Anglia, UK. *Journal of Cleaner Production*. 2004;12(5):505-12.
13. Lynes JK. & Andrachuk M. Motivations for corporate social and environmental responsibility: A case study of Scandinavian Airlines. *Journal of International Management*. 2008;14(4):377-90.
14. Slaper TF. & Hall TJ. The Triple Bottom Line: What Is It and How Does It Work? *Indiana Business Review*. 2011;86(1):4-8.
15. World Menu Report: Global Research Findings. Unilever Food Solutions, 2011.



16. Kautto P. & Melanen M. How does industry respond to waste policy instruments—Finnish experiences. *Journal of Cleaner Production*. 2004;12(1):1-11.
17. Withana S., Baldock D., Farmer A., Pallemmaerts M., Hjerp P., Watkins E., Armstrong J., Medarova-Bergstrom K., Gantioler S. *Strategic Orientations of EU Environmental Policy Under the Sixth Environmental Action Programme and Implications for the Future: Report for the IBGE-BIM, IEEP*. London: 2010.
18. Parliament NZ. *Bill Digests: Food Bill 2010 (2012 No 160-2)*: John McSoriley; 2013 [13/11/14]. Available from: <http://www.parliament.nz/en-nz/pb/legislation/bills/digests/50PLLaw20541/food-bill-2010-2010-no-160-2-bills-digest-no-2054>.
19. Payne-Palacio J. & Theis M. . *Food Service Management: principles and practices* 12th ed. Upper Saddle River, New Jersey Prentice Hall 2012. Chapter 12: Resource Conservation. p. 343-50.
20. Quested T., Eastel S., Ingle R. *Methods used for Household Food and Drink Waste in the UK 2012*. WRAP, 2013.
21. Arendt S., Roberts K., Strohbahn C., Ellis J., Paez P., Meyer J. Use of Qualitative Research in Foodservice Organizations: A review of challenges, strategies and applications. *International Journal of Contemporary Hospitality Management* 2012;24(6):820-37.
22. Pedrick D, Babakus E, Richardson A. The value of qualitative data in quality improvement efforts. *The Journal of Services Marketing*. 1993;7(3):26
23. Price JL. & Joseph JB. Demand management – a basis for waste policy: a critical review of the applicability of the waste hierarchy in terms of achieving sustainable waste management. *Sustainable Development*. 2000;8(2):96-105.
24. Nunley M. "From Farm to Fork to Landfill: Food Waste and Consumption in America" 2013.
25. Whitehair K., Shanklin C., Brannon L. Written messages improve edible food waste behaviors in a university dining facility. *Journal of the Academy of Nutrition and Dietetics*. 2013;113(1):63-9.
26. Englund EH., Breum G., Friis A. Optimisation of large-scale food production using Lean Manufacturing principles. *Journal of Foodservice*. 2009;20(1):4-14.
27. Heracleous L., Wirtz J., Johnston R. Cost-Effective Service Excellence: Lessons from Singapore Airlines. *Business Strategy Review*. 2004;15(1):33-8.
28. Peregrin T. Sustainability in Foodservice Operations: An Update. *Journal of the American Dietetic Association*. 2011;111(9):1286-94.
29. Cusumano MA. The Limits of "Lean". *Sloan Management Review*. 1994;35:27

30. Goetz AR. & Graham B. Air transport globalization, liberalization and sustainability: post-2001 policy dynamics in the United States and Europe. *Journal of Transport Geography*. 2004;12(4):265-76.
31. Li XD., Poon CS., Lee SC., Chung SS., Luk F. Waste reduction and recycling strategies for the in-flight services in the airline industry. *Resources, Conservation and Recycling*. 2003;37(2):87-99.
32. Loughlin C. Qantas Automates Airline Catering. *Assembly Automation* 1991;11(4):22-5.
33. Johan N. & Jones P. Forecasting the demand for airline meals.
34. Jones P. & Thomas M. Innovation in Flight Catering: Who? What? And how? 2003.
35. Payne-Palacio J. & Theis M. *Foodservice Management: principles and practices*. 12th ed. Upper Saddle River, New Jersey Prentice Hall; 2012. Chapter 2: the systems approach. p. 48-58.
36. Sangasubana N. How to Conduct Ethnographic Research. *The Weekly Qualitative Report*. 2009;2(36):208-14
37. Food Management (NZ) Ltd. Document analysis sheet. 2008.
38. Braun V. & Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology*. 2006;3(2):77-101.
39. Jiao J, Tseng MM, Ma Q, Zou Y. Generic bill-of-materials-and-operations for high-variety production management. *Concurrent Engineering*. 2000;8(4):297-321.
40. Tagtow A., Robien K., Bergquist E., Bruening M., Dierks L., Hartman BE. Academy of Nutrition and Dietetics: Standards of Professional Performance for Registered Dietitian Nutritionists (Competent, Proficient, and Expert) in Sustainable, Resilient, and Healthy Food and Water Systems. *Journal of the Academy of Nutrition and Dietetics*. 2014;114(3):475-88.e24.

## Appendices

## Appendix A: Ethical Approval



D14/010

Academic Services  
Manager, Academic Committees, Mr Gary Witte

17 January 2014

Dr M Mirosa  
Department of Human Nutrition  
Division of Sciences

Dear Dr Mirosa,

I am writing to let you know that, at its recent meeting, the Ethics Committee received a copy of the Reporting Sheet relating to your Category B ethics proposal entitled "Food Waste in the Production Kitchen of an In-Flight Services Provider: Investigating what, where, why, who and how?".

For your future reference, the Ethics Committee's reference code for this project is:- D14/010.

The Committee appreciates that Category B proposals may commence as soon as approval has been obtained at departmental level and that, in some instances, the research or teaching may be well advanced or even completed by the time the Reporting Sheet is received by the Committee.

Nonetheless, in the case of this particular proposal (D14/010), the Ethics Committee has recorded a status for it of **Approved HOD** at this stage, and has asked me to pass on its views to you as follows:-

The Committee would be grateful if you could provide evidence that [REDACTED] agree to this research being undertaken.

The Committee would be grateful if you could clarify whether the kitchens to be audited are on the ground only or would they include aircraft?

Yours sincerely,

A handwritten signature in black ink that reads "Gary Witte".

Mr Gary Witte  
Manager, Academic Committees  
Tel: 479 8256  
Email: gary.witte@otago.ac.nz

c.c. Emeritus Professor L J Holloway Head Department of Human Nutrition

**Appendix B: Data Collection Tool; Bin Identification form**

Bin Identification form

<b>BIN ID # :</b>	<b>Date:</b>
<b>Area:</b>	
<b>All waste:</b>	<b>kg</b>
<b>Non food waste:</b>	<b>kg</b>

<b>BIN ID # :</b>	
<b>All waste:</b>	<b>kg</b>
<b>Non food waste:</b>	<b>kg</b>

<b>BIN ID # :</b>	
<b>All waste:</b>	<b>kg</b>
<b>Non food waste:</b>	<b>kg</b>

<b>BIN ID # :</b>	
<b>All waste:</b>	<b>kg</b>
<b>Non food waste:</b>	<b>kg</b>

<b>BIN ID # :</b>	
<b>All waste:</b>	<b>kg</b>
<b>Non food waste:</b>	<b>kg</b>

<b>BIN ID # :</b>	
<b>All waste:</b>	<b>kg</b>
<b>Non food waste:</b>	<b>kg</b>

<b>BIN ID # :</b>	
<b>All waste:</b>	<b>kg</b>
<b>Non food waste:</b>	<b>kg</b>

Appendix C: Food Waste Audit form

<b>BIN ID:</b> <i>Example</i>			
<b>FULL DESCRIPTION</b>			
Food: <i>Kumara 10mm</i>		Weight: <i>6.0kg</i>	
Category: <i>B</i>		Comments:	
Menu item:			
Source of waste: <i>Best before</i>			
PACKAGING <input type="checkbox"/> None <input checked="" type="checkbox"/> Opened <input type="checkbox"/> Unopened <input type="checkbox"/> Recyclable			
Weight <i>40</i> g	Pack size & type <i>Plastic vacuum pack</i>	Date on pack <i>05/07/14</i>	<i>BB4</i> <input checked="" type="checkbox"/> Use by <input type="checkbox"/>
<b>FULL DESCRIPTION</b>			
Food:		Weight:	
Category:		Comments:	
Menu item:			
Source of waste:			
PACKAGING <input type="checkbox"/> None <input type="checkbox"/> Opened <input type="checkbox"/> Unopened <input type="checkbox"/> Recyclable			
Weight g	Pack size & type	Date on pack / /	<i>BB4</i> <input type="checkbox"/> Use by <input type="checkbox"/>
<b>FULL DESCRIPTION</b>			
Food:		Weight:	
Category:		Comments:	
Menu item:			
Source of waste:			
PACKAGING <input type="checkbox"/> None <input type="checkbox"/> Opened <input type="checkbox"/> Unopened <input type="checkbox"/> Recyclable			
Weight g	Pack size & type	Date on pack / /	<i>BB4</i> <input type="checkbox"/> Use by <input type="checkbox"/>
<b>FULL DESCRIPTION</b>			
Food:		Weight:	
Category:		Comments:	
Menu item:			
Source of waste:			
PACKAGING <input type="checkbox"/> None <input type="checkbox"/> Opened <input type="checkbox"/> Unopened <input type="checkbox"/> Recyclable			
Weight g	Pack size & type	Date on pack / /	<i>BB4</i> <input type="checkbox"/> Use by <input type="checkbox"/>

## Appendix D: Recommendations for Sorting

### Recommendations for Kitchen Waste Audit Sort Equipment

- Tables, for sorting on – elbow height most comfortable
- Tarpaulin, to cover table
- Scales, one kitchen set per pair of staff, plus one capable of weighing whole bags of rubbish
- Protective gloves, one pair for each staff member
- A knife, for ease of opening rubbish bags

- 1) Weigh all waste, record weight
- 2) Separate all non-food waste (it is practical to begin sorting food items, as described below)
- 3) Weigh non-food waste, record weight

- A dustpan or other small container, to weigh pile of food waste
- A spatula, for removing liquid food waste from packaging (e.g. humus, yoghurt)
- Large container, to collect and weigh non-food waste
- Bins, to dispose of all waste after it was sorted and weighed

For each household's waste – record on *Form 1*

- 1) Weigh all waste, record weight
- 2) Separate all non-food waste (it is practical to begin sorting food items, as described below)

<p>1) If item <b>is not</b> in packaging:</p> <ul style="list-style-type: none"> <li>➤ Place item into pile: <ul style="list-style-type: none"> <li>i. Food type (e.g. potato chips)</li> <li>ii. Food preparation state (e.g. Ready to eat when purchased)</li> </ul> </li> </ul> <p>2) When all waste from one household has been sorted, weigh the piles</p> <ul style="list-style-type: none"> <li>➤ <u>Record Household ID#</u></li> <li>➤ <u>Record food type and preparation state of each</u></li> <li>➤ <u>Record weight of each</u></li> </ul>	<p>1) If item <b>is</b> in packaging:</p> <ul style="list-style-type: none"> <li>➤ <u>Record item description</u></li> <li>➤ Remove food from packaging</li> <li>➤ Weigh food item, <u>record weight</u></li> <li>➤ Record packaging: <ul style="list-style-type: none"> <li>i. <u>Weight</u></li> <li>ii. <u>State</u> (opened/unopened)</li> </ul> </li> </ul> <p>And, if available:</p> <ul style="list-style-type: none"> <li>iii. <u>Weight / volume / amount of pack</u></li> <li>iv. <u>Best before / use by date</u></li> <li>v. <u>Brand</u></li> </ul>
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## Appendix E: Observation Protocol

### Observations protocol

Pre-observation checklist:

- Pen and pencil
- Highlighters
- Site map
- Observation checklist sheet
- Blank paper
- Clipboard

Observations will be conducted on the first day at each site and at random throughout data collection period. Observations will be conducted in a fashion causing minimal disruption to the work environment.

As suggested by Sangasubana (36) observations will be recorded using the following methods

- Running description, an accurate account of what is being observed. Times are to be recorded every hour to help set a timeline of events;
- Forgotten episodes, recorded if a past episode is remembered (observation documentation will be titled with forgotten episode and approximate time/date);
- Ideas and notes for further information use, documenting ideas or speculations regarding observations, any ideas for extra interview questions or methods for waste audits will be recorded here;
- Personal impressions, will be recorded as may help identify areas of bias;
- Methodological notes, recording ideas had about techniques used during data collection.

Each collection method will have its own sheet for recording notes on, these will be filed at the end of the day for future reference. In addition to these free-hand notes the observation checklist sheet and site map will assist in documentation of observations.



## Appendix F: Observation Checklist

System Component		Waste produced	Comments/observation about food waste
<b>Inputs</b>	<b>People</b>		
	<b>Materials</b>		
	Food		
	Non-food supplies		
	Packaging		
	<b>Facilities</b>		
	Space		
	Equipment		
	<b>Operational</b>		
	Energy		
	Water		
	Time		
	\$		
	Information		
<b>Transformation</b>	Purchasing		
	Receiving		
	Storage		
	Key tasks		
	<i>Preparation</i>		
	<i>Production</i>		
	<i>Meal Service</i>		
	Distribution		
	Cleaning		
	Maintenance		

		Waste produced	Comments/observations about food waste
<b>Controls</b>	<b>Plans</b>		
	Goals, objectives		
	Policies, procedures		
	Menus		
	Standards		
	<b>Programmes</b>		
	Training		
	QA		
	Benchmarking		
	Audit		
	<b>Contracts</b>		
	Service		
	Purchasing		
	Specifications		
	<b>Legislation</b>		
	Food safety		
	Health & safety		
	Environmental (e.g., EREP in VIC)		
<b>Linking processes</b>	Communication		
<b>Management Functions</b>	Plan, organise, direct, control etc		
<b>Memory</b>	Records: Financial		
	Personnel		
	Performance		

## Appendix G: Document Analysis Checklist

Document analysis checklist

System Component		Waste produced	Comments/observation about food waste
<b>Inputs</b>	<b>People</b>		
	<b>Materials</b>		
	Food		
	Non-food supplies		
	Packaging		
	<b>Facilities</b>		
	Space		
	Equipment		
	<b>Operational</b>		
	Energy		
	Water		
	Time		
	\$		
	Information		
<b>Transformation</b>	Purchasing		
	Receiving		
	Storage		
	Key tasks		
	<i>Preparation</i>		
	<i>Production</i>		
	<i>Meal Service</i>		
	Distribution		
	Cleaning		
	Maintenance		

System Component		Waste produced	Comments/observations about food waste
<b>Controls</b>	<b>Plans</b>		
	Goals, objectives		
	Policies, procedures		
	Menus		
	Standards		
	<b>Programmes</b>		
	Training		
	QA		
	Benchmarking		
	Audit		
	<b>Contracts</b>		
	Service		
	Purchasing		
	Specifications		
	<b>Legislation</b>		
	Food safety		
	Health & safety		
	Environmental (e.g., EREP in VIC)		
<b>Linking processes</b>	Communication		
<b>Management Functions</b>	Plan, organise, direct, control etc		
<b>Memory</b>	Records: Financial		
	Personnel		
	Performance		

## Appendix H: Interview Protocol and Question Guide

### Interview protocol

Checklist:

- Audio recorder
- Interview question guide
- Consent forms
- Pen and paper
- Name badge

Instructions:

1. Set up interview room with audio recorder, question guide, consent form
2. Meet participant and explain interviews purpose and go through consent form
3. Get consent form signed and turn on the audio recorder
4. Conduct interview based on the interview guide (below)
5. When interview is complete, thank the participant for coming and turn off audio recorder

### Interviewer guide:

*This is a guide only, due to the semi-structured nature of the interviews, questions may adjusted during the interview period attain all possible data and best fit the interviewee.*

Welcome, my name is Jessie Ross, I am a student of the University of Otago doing research for my Masters of Dietetics. Please read the information sheet, if you have any questions feel free to ask. Once you have read the information sheet and are comfortable taking part in this interview please sign the consent form and we will start.

As part of my research, I am looking at food waste produced in the production kitchens.

Today I would like to focus on the food waste that occurs during time of production. That is food which is thrown out at any point from when it arrives off the truck to right before it leaves for the plane. I am interested in gathering your opinions, thoughts and observations around this topic of food waste. We will have about 30minutes/1hour.

When you are working in the kitchen what thoughts do you have about the food being thrown out?

Are there any rules or guidelines about what is waste? Who makes decisions around what food should be thrown out? *For example how many days a product is kept before thrown out.*

How do you think the food waste has changed in the time that you have worked here?

Are there practices you have observed or carried out that decrease food being thrown out? What about things that increase? *For example using ingredients in a different menu.*

Do you think food being wasted is an issue in this kitchen? Do you think other staff see it as a problem?

What do you think the benefits of decreasing food thrown out could be?

Do you think it would be hard to waste less food? What do you think might make it hard/what do you think might make it easier?

Where do you think the most food waste is happening? Why?

Who do you think is or should be responsible for monitoring food waste?

What are your thoughts on food waste as an issue in general? *Inside and outside of work*

*Following (italicised) questions targeted at management staff:*

*Has there been a waste audit completed before? Is there any form of waste information collected e.g. bins weighed? What is done with this information?*

*Would it be feasible to have an on-going waste tracking system? Why/why not? Who could be in charge?*

*Is there external pressure e.g. from airlines for your company to have a more sustainable focus? How do these effect decisions that are made?*

*What is company policy on what is done with food waste? Why? Is there space for negotiation?*

*Is food waste a concern for this company? At what level is it most concerning?  
e.g. financial, social, environmental?*

Is there anything else you would like to mention before we finish up?

Thank you for your time today.

## **Appendix I: Information Sheet for Participants**

### **“Food Waste in the Production Kitchen of an In-Flight Services Provider: Investigating what, where, why, who and how?” INFORMATION SHEET FOR INTERVIEW PARTICIPANTS**

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate, I thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

#### **What is the Aim of the Project?**

The overall aim of this project is to assess and quantify production food waste in an in-flight service provider kitchen, investigating why the waste is being produced and developing recommendations for what can be done to prevent, reduce or divert the waste.

#### **What Type of Participants are being sought?**

Production kitchen staff and management staff

#### **What will Participants be Asked to Do?**

Should you agree to take part in this project, you will participate in an interview with the researcher in an interview room at your place of work, during working hours. This will take approximately 30 minutes of your time. Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind.

#### **What Data or Information will be Collected and What Use will be Made of it?**

Should you accept to participate in the interview, you will be asked to discuss your perceptions attitudes and practices around food waste during the production of inflight meals. The interview sessions will be audio recorded to allow the researcher to remember and accurately transcribe what was said during the session. Neither the audio recordings, nor the transcripts, will be shared with anyone outside the current research project.

Nothing that you say during the course of the session will be disclosed to any person outside of the interview session. After the interview, the audio file will be transcribed and your real name will be removed from the data and replaced with a pseudonym so that outsiders reading the final report cannot identify your real name.

Any personal information that you provide will only be used to assist in explaining the study results. Personal information will be published only as aggregate values (e.g. total number of kitchen assistants included). Responses will be collected and transferred onto a USB memory-stick that will be stored in



a lockable filing cabinet in Dr Miranda Miroso's office in the University of Otago. The data will only be accessible to Jessie Ross (researcher) and, Dr. Heather Spence and Dr. Miranda Miroso (academic supervisors), as required by the University's research policy. Any raw data on which the results of the project depend will be retained in secure storage for five years, after which time they will be destroyed.

The results of the project may be published in which case they will be available in the University of Otago Library (Dunedin, New Zealand). Every attempt will be made to preserve your anonymity.

You are most welcome to request a summary of the study results. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (phone 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

#### **What if Participants have any Questions?**

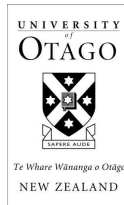
If you have any questions about our project, either now or in the future, please feel free to contact either:

Jessie Ross                      and/or  
Department of Human Nutrition  
Email: [jessie.ross@otago.ac.nz](mailto:jessie.ross@otago.ac.nz)

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Department of Food Science  
Email: [miranda.miroso@otago.ac.nz](mailto:miranda.miroso@otago.ac.nz)  
Telephone: 03- 479 7953

\*This study has been approved by the Department stated above. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479-8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

## Appendix J: Interview Consent form



### **“Food Waste in the Production Kitchen of an In-Flight Services Provider: Investigating what, where, why, who and how?”**

#### **CONSENT FORM FOR PARTICIPANTS**

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage. I know that:

1. My participation in the project is entirely voluntary;
2. I am free to withdraw from the project at any time without any disadvantage;
3. The data will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for at least five years;
4. This project involves an open-questioning technique. The general line of questioning includes ‘Where and why do you think food waste is being created in the kitchen?’. The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops and that in the event that the line of questioning develops in such a way that I feel hesitant or uncomfortable I may decline to answer any particular question(s) and/or may withdraw from the project without any disadvantage of any kind.
5. Interviews are being conducted in work time and I will continue to be paid for this time.
6. The results of the project may be published and available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve my anonymity.

I agree to take part in this project.

.....  
.....  
(Signature of participant)