Significance of Meal Forecasting in Airline Catering on Food Waste Minimization

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Abstract

Forecasting demand for products and services in the airline industry is particularly important. Research objectives are to assess the relationship of meal demand variance and kitchen wise waste per meal and to identify the importance of having forecasted meal demands before 24 hours to the estimated time of departure (ETD). Initial meal demand, final meal demand, meal demand variance and number of meals catered per day are the independent variables, and the dependent variable is production waste per meal (kg). A combination of descriptive research, correlation research and applied research were used. The population of this study was all the airlines catered to from July to October 2017. The selected sample for the study was 75% percent of total meals and 80% of sectors during the research period. Irrespective of the month, the pattern of the average daily meal count for weekdays has continued throughout the period of the research. Each sub kitchens has reported the lowest average waste per meal on August which is the Peak period with highest meal demand of the research period.

The least waste per meal and the standard deviation were detected in the confectionery. Minimum waste per meal was achieved when the initial meal demand was 100% of the flight with zero meal demand variance. The highest portion of average waste per meal was generated by the vegetable room followed by the hot kitchen. The average meal demands of all the classes of the airlines have increased representing that the risk of the increasing of the meal demands within last 24 hours has transferred to the caterer by the airline. The company has to invest for a better forecasting system and should search for other options such as standard meals for the increases (Meal Bank), standard uplift with the agreement of the customer airline to uplift standard quantity of meals for each class.

Keywords: Food Waste, Flight Catering Industry, Meal Forecast, Variance, Initial Meal Demand, Final Meal Demand, Estimated Time of Departure

INTRODUCTION

The tourism industry is a highly variable industry and the seasonality has a significant impact on the demand for the airline industry with travel patterns being most unpredictable. The passenger airline industry operates on low profit margins with many competitors. Airline carriers sustain profitability through operational efficiency improvements and by maintaining or increasing market share (Jason, 1999). Catering Flights is an important part of an airline's operations. The meal service has a critical impact on customer service quality and represents significant costs. Unfortunately, due to high passenger load variability and minimum production lead-time requirements, it is difficult to get the number of meals to exactly match the passenger count on each flight. (Morency,1999).The flight catering is a very large, global industry. The total market size is estimated to be around 12 billion euros. More than 1 billion passengers are served each year. It is probably one of the most complex operational systems in the world (Jones, 2007).

Forecasting demand for the products and services in the airline industry is particularly important. Importance of forecasting the meal demand for the passengers by seat class as the meal options, quality and number of meals needed vary between classes. Forecasting meal demand 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 the flight. Research conducted by the Travel Catering Research Centre found that the caterers made little contribution to innovations inflight catering. Furthermore, there has been a minimum focus on the food as an area for new product development (Jones, 2007).

There is a variability between the initial passenger loads and the final passenger loads provided by the customer airline within 24 hours to the estimated time of departure and this has created an uncertainty in the Production Floor of a flight catering company. The average daily Flight kitchen waste per meal fluctuate throughout the year and this affect average profit margin (Profit per Meal) significantly.A catering system has to be designed and organized to produce the right quantity of food at the correct standard, for the required number of people, on time and using the resources of staff, equipment and materials effectively and efficiently. A central constraint is that inflight catering, production is separated from service by distance and time(Jones, 2004).Significant lead time is required to produce a meal order. Meal provisioning involves preparation, cooking, assembling, blast chilling/ chilling and transporting the meal order, and in some airports, large flights depart within minutes of each other (Jason, 1999).There is a variation of the average daily waste per meal in a flight catering company. Production of the flight kitchen vary in terms of total Pax count, types of meals, airline classes, etc. The average daily kitchen waste is fluctuating throughout the year. The average profit margin (Profit per Meal) is significantly depending on the average waste per meal.This research will guidethe flight catering companies to identify the importance of having accurate forecasting system to identify, measure and control the production waste.

RESEARCH OBJECTIVES

The research was conducted in order to,

- Assess the relationship ofmeal demandvariance and kitchen wise waste per meal

- Identify the importance of having forecasted Meal demands before 24 hours to the estimated time of departure (ETD)

METHODOLOGY

The research was conducted in the Flight Catering Company in Sri Lanka. Initial meal demand, final meal demand, meal demand variance and the number of meals catered per day are the independent variables, and the dependent variable is production waste per meal (kg). A combination of descriptive research, correlation research and the applied research were used. The population of this study was all the airlines catered to from July to October 2017. Stratified and judgmental sampling techniques were used for sampling procedure. Primary data collection form which was developed to collect the daily kitchen waste (kg) was used as the main research instrument of the research.The passenger flight loads data were collected using a secondary data collection method which was found suitable to the context of the study.

The selected sample for the study was two Airlines which generated 75% percent of total meals demand and 80% of the sectors, catered by the Flight Catering Company during the research period. Meal demand data were collected using secondary data collection method from the Inflair ERP system and the production waste data was collected using primary data collection sheet. The data analysis was done using the MINITAB statistical software. The descriptive data analysis, simple linear regression, Pearson Correlation Coefficient techniques were mainly used in data analysis.

In the empirical analysis multiple linear regression analysis was employed. Using the regression analysis, function y = f(x) was analysed.

$$\textbf{\textit{Daily Flight Kitchen Waste per Meal}} = \alpha * \textbf{\textit{Meal Demand Variance}} + \varepsilon$$

α: Coefficient, ε: Error, Meal Demand Variance = Final Meal demand – Initial MealDemand

Pearson - Correlation Coefficient

- No of Meals per Day Vs. Kitchen Waste Per Meal
- Meal DemandVariance Vs. Individual Kitchen Waste Per Meal

Research Hypothesis

- H_0 : Meal DemandVariance and Production Waste Per Meal(kg) are independent
- H_A : Meal DemandVariance and Production Waste Per Meal(kg) are associated

RESULTS AND DISCUSSION

Descriptive analysis was used to provide summary of the data collected from the sample of the study.

Table 1.1: Population of the Research

	July	August	September	October
Total Meal Count	613072	715675	627928	620676
No of flights	3082	3234	3134	3272
No of Sectors	4263	3694	3553	3703

The population of the research was all the regular and charter flights catered by the flight catering company in the period of July to October 2017. The purpose of selecting this

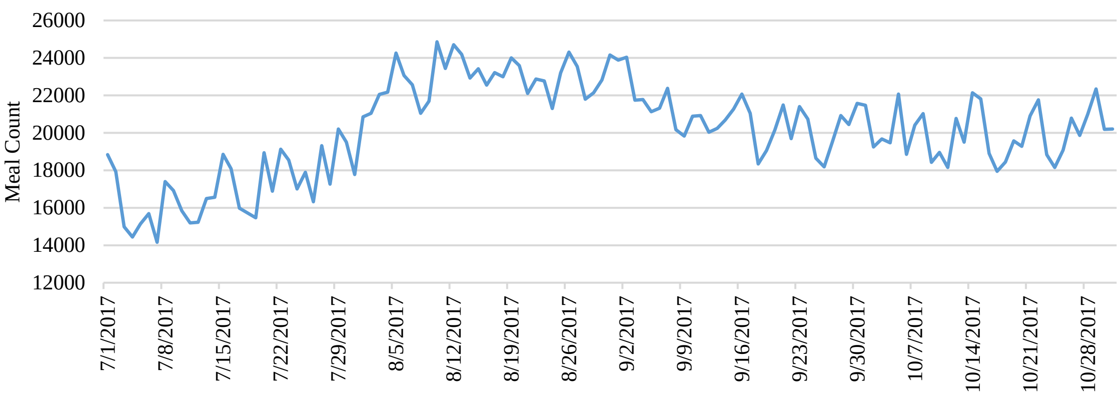


Figure 1.2: Daily Meal Demand Fluctuation

period was the period included both peak month (August- Total Meal Demand 715675) and off-peak months (July – Total Meal Demand 613072) for the company production. The selected sample flights meal demands, represent approximately 80% of the population of the Research. Approximately 80% of the total production is represented by the selected Sample for the Period of July to October 2017.

The figure1.2represent the daily meal demand fluctuation of the Period from July to October 2017. The daily meal demand has fluctuated from 24861 (maximum) on 10th August 2017 to 14156 (minimum) 07thJuly 2017.

The figure 1.3 represents the fluctuation of the total daily waste in each Sub-kitchen in the production department in kilograms (kg).

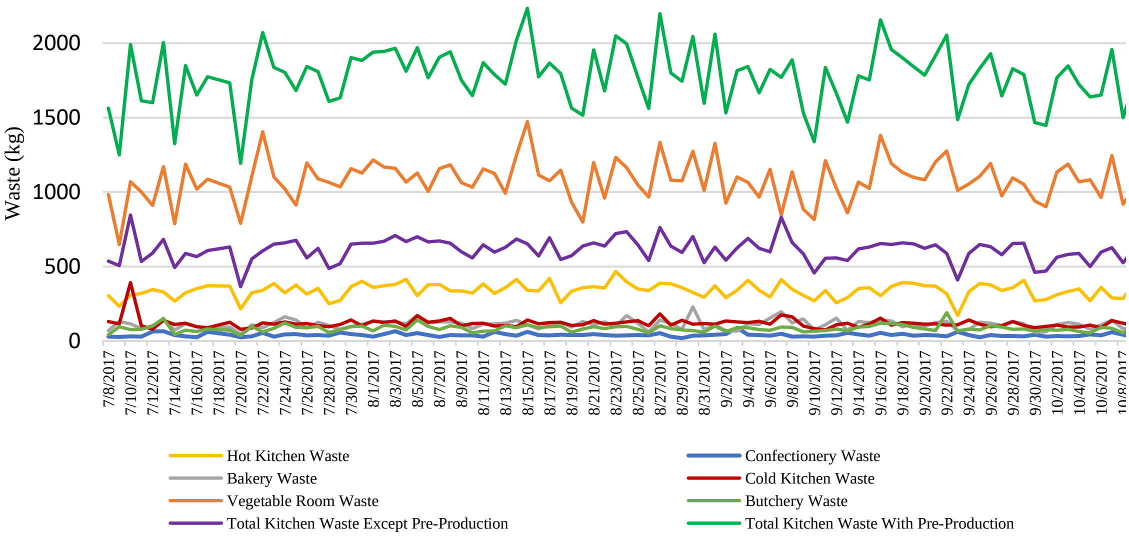


Figure 1.3: Total Daily Waste (kg) in Production Department

Irrespective of the month, the pattern of the average daily meal count for weekdays has continued throughout the period of the research (Figure 1.4).

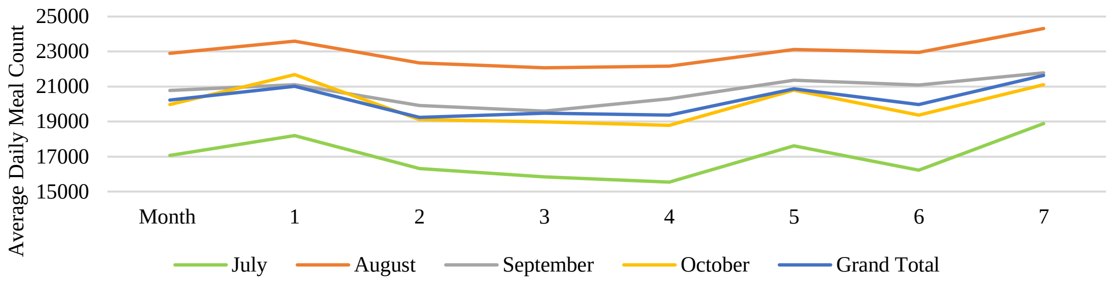


Figure 1.4: Daily Average Meal Count of the Population- Week Day Wise

The figure 1.5 represents the variation of the average waste per meal in kilograms from July to October 2017. Each sub kitchen has reported the lowest average waste per meal in August which is the peak period with highest meal demand of the research period. The highest waste has reported in the month of October. The provision for the potential demand increases has caused the increasing of the average waste per meal due to the uncertainty in the production line without accurate forecast of the final meal demand. The impact on the upstream of the supply chain has represented by the increasing of waste per meal significantly in the upstream (pre- production) due to the supply chain bullwhip effect.

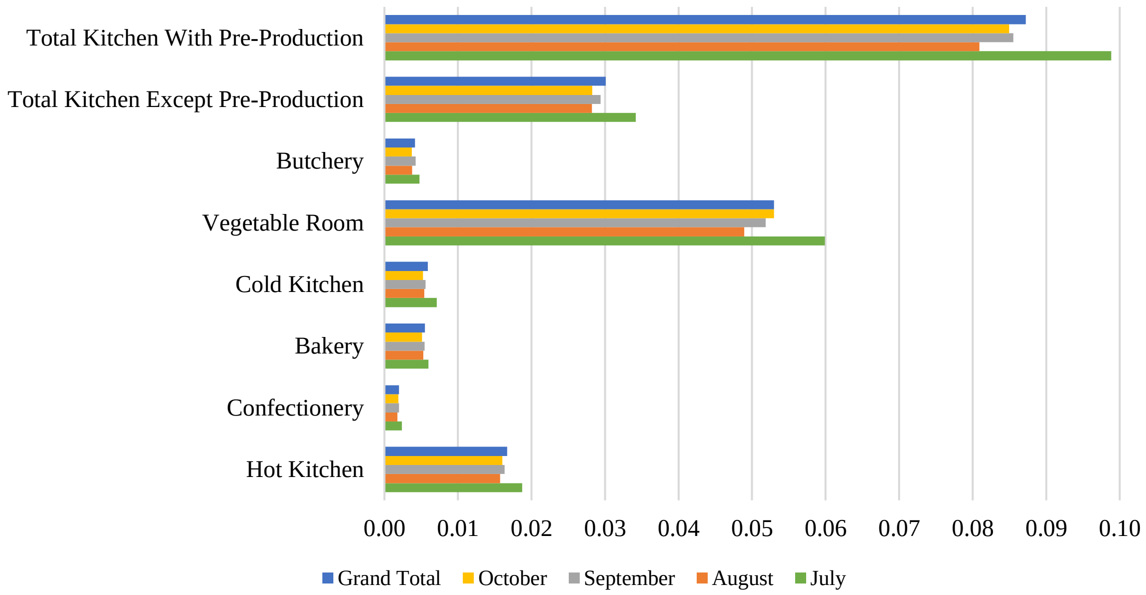


Figure 1.5: Daily Area Wise Average Waste per Meal - Monthly

The highest waste per meal and the standard deviation were detected in pre-production (Figure 1.6). The least waste per meal and the standard deviation were detected in Confectionery. The highest portion of average waste per meal has generated by the vegetable room followed by the hot kitchen. The Figure 1.6 graphically represents the daily area wise average waste per meal for the period from July to October 2017. According to the Figure 1.6 area chart the highest portion of the average waste per meal is generated by the vegetable room then the hot kitchen. Minimum proportion has incurred by the Confectionery

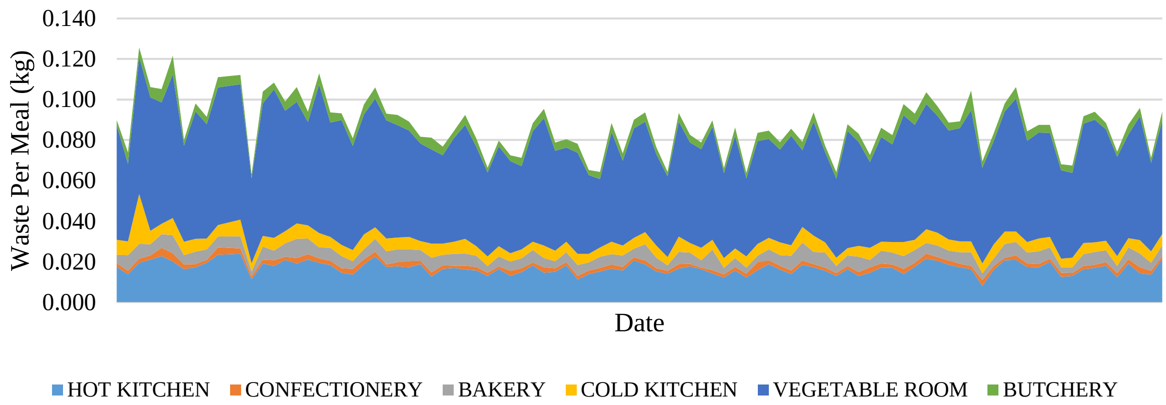


Figure 1.6: Daily Area Wise Waste per Meal

Referring to the figure 1.7 the comparison of the pre-production (vegetable room and butchery) and the production (hot kitchen, cold kitchen, confectionery and the bakery) contribution for the total average waste per meal has followed the popular Pareto Theory which is 80% of the average waste per meal was generated from the pre-production (vegetable room and butchery) and the balance 20% was generated from the other sub kitchens (hot kitchen, cold kitchen, Confectionery and the bakery). Sub kitchens represent the lowest average waste per meal on August which is the peak period with

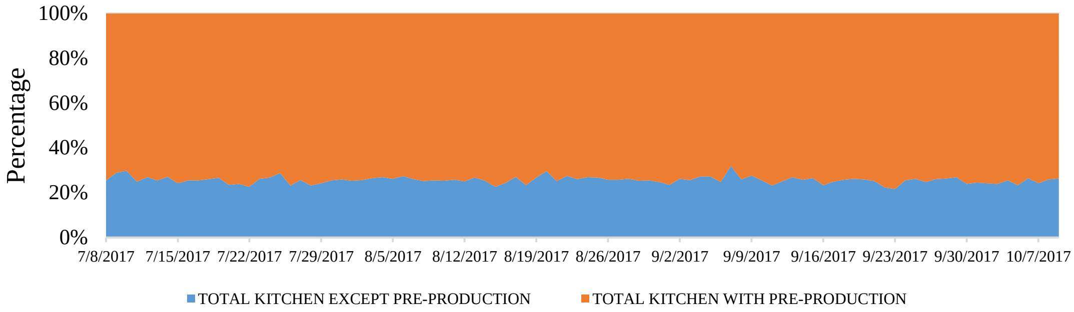
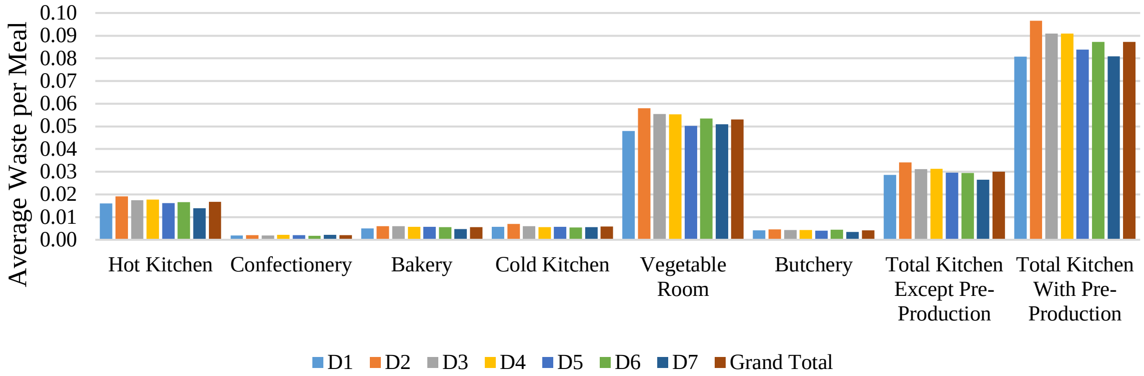


Figure 1.7: Total Waste Analysis - Per Production vs. Production

highest meal demand.

The figure 1.8 graphically represents the daily fluctuation of the average waste per meal in the period of July to October 2017 with respect to each week day for each sub kitchens.The highest average waste per meal 0.019 kg / per meal has generated on day number 2 (Monday) in hot kitchen, highest average waste per meal in Bakery has reported on day number 02/03/04/05/06 (Monday, Tuesday, Wednesday, Thursday and Friday) as 0.005 kg per meal, for cold kitchen the highest average waste per meal is generated on day number 2 (Monday), in vegetable room the highest average waste per meal 0.058 kg per meal on day number 02 (Monday), butchery the 0.005 kg waste per meal on day number 02 (Monday). The total average waste per meal with and without pre-production has generated on day number 02 (Monday) following 0.034 kg per meal and 0.097 kg per meal.

Figure 1.8: Daily Average Waste per Meal – Week Day Wise



Minimum wastes per meal were reported as, hot kitchen day number 07 (Saturday) with 0.014 kg per meal, bakery day number 01/07(Saturday/ Sunday) with 0.005 kg per meal, vegetable room 0.048 kg per meal on day number 01 (Sunday), butchery day number 07(Saturday), total kitchen except pre-production on day number 07 (Saturday) with 0.027 kg per meal and finally total production with pre-production on day number 01/ 07 (Sunday and Saturday) with 0.081 kg per meal.

Linear Regression – First Class (FC)Meal Demand Variance

The below linear regressions summarize the relationships of average waste per meal in each sub kitchens with FC meal demand variance,except bakery all the other sub kitchens have negative linear relationships with the FC meal demand variance, indicating that the increasing of FC meal demand will marginally reduce the average waste per meal. This is due to the provision for the potential meal demand increased by the production staff when they receive the initial meal demand for the first class, and the possibility of share some product components for the increased meal demands which have currently preparedas bulk in pre-production.

Average Waste per Meal in Hot Kitchen = 0.016692 - 0.000124FC Meal Demand Variance

Average Waste per Meal in Confectionery = 0.001996 - 0.000008FC Meal Demand Variance

Average Waste per Meal in Bakery = 0.005500 + 0.000000FC Meal Demand Variance

Average Waste per Meal in Cold Kitchen = 0.005906 - 0.000069 FC Meal Demand Variance

Average Waste per Meal in Vegetable Room = 0.053026 - 0.000501 FC Meal Demand Variance

Average Waste per Meal in Butchery = 0.004172 - 0.000037 FC Meal Demand Variance

Average Waste per Meal in Total Kitchen Except Pre Production = *0.030095 - 0.000201 FC Meal Demand Variance*

Average Waste per Meal in Total Kitchen With Pre Production = *0.087293 - 0.000738 FC Meal Demand Variance*

The number of components (separable components in the final product) in the bakery final product is less compared to the cold meal or hot meals where the bakery has to specifically produce the products for the first class meal which has led to an increase of the waste with the increase of meal demand in first class. All most all the kitchens have to specifically produce the components for the first class meal since the there is a Significant variance in the components in the first class. Also the production team commence the production once they receive the initial meal demand, since the number of meals are less and to avoid waste and the significant unpredictability in forecasting the meal demands in first class.The First Class meal has led to an increase of waste, because kitchens produce customised products for first class meals with less standardization and the lack of mass production of such meals.

Linear Regression – Business Class (BC)Meal Demand Variance

Average Waste per Meal in Hot Kitchen = 0.016670 - 0.000004 BC Meal Demand Variance

Average Waste per Meal in Confectionery = 0.002001 - 0.000003 BC Meal Demand Variance

Average Waste per Meal in Bakery = 0.005477 + 0.000014 BC Meal Demand Variance

Average Waste per Meal in Cold Kitchen = 0.005840 + 0.000004 BC Meal Demand Variance

Average Waste per Meal in Vegetable Room = 0.052895 - 0.000002 BC Meal Demand Variance

Average Waste per Meal in Butchery = 0.004145 + 0.000006BC Meal Demand Variance

Average Waste per Meal in Total Kitchen Except Pre-Production = 0.029988 + 0.000011 BC Meal Demand Variance

Average Waste per Meal in Total Kitchen With Pre-production = 0.087027 + 0.000015 BC Meal Demand Variance

The BC meal demand variance has significantly negative correlate with the waste per meal in hot kitchen, confectionery and vegetable room sub areas in the production department. This represents that the pre-preparation of the meals in advance for the business class meal demands because if the meal demand increases the average waste per meal get reduced, vice versa. The minimum waste per meal has achieved when the BC meal demand variance was minimum in hot kitchen, confectionery and the vegetable room. Because the risk to the producer for potential increasesis zero, because of that the producer can produce the exact quantity and the risk taken by the pre-production by producing the full configuration in advance is match with the initial meal demand received.

Linear Regression – Economy Class (EY) Meal Demand Variance

Average Waste per Meal in Hot Kitchen = *0.016662 + 0.000002 EY Meal Demand Variance*

Average Waste per Meal in Confectionery = *0.001999 - 0.000000 EY Meal Demand Variance*

Average Waste per Meal in Bakery = *0.005486 + 0.000002 EY Meal Demand Variance*

Average Waste per Meal in Cold Kitchen = *0.005843 + 0.000000 EY Meal Demand Variance*

Average Waste per Meal in Vegetable Room = *0.052870 + 0.000012 EY Meal Demand Variance*

Average Waste per Meal in Butchery = *0.004146 + 0.000002 EY Meal Demand Variance*

Average Waste per Meal in Total Kitchen Except Pre-Production = *0.029989 + 0.000005 EY Meal Demand Variance*

Average Waste per Meal in Total Kitchen With Pre-production = *0.087005 + 0.000019 EY Meal Demand Variance*

The linear regressions of EY-meal demand variance has indicated a positive correlation with the average waste per meal in all the sub- kitchens except confectionery. When the EY-meal demand has increased the average Waste per meal also has increased, vice versa, except the Confectionery. The increases in the meal demands in the last 24 hours to the estimated time, the average waste per meal has increased due to the discrepancies to the continuous production flow. Better forecasting of this factor will significantly control the average waste per meal in bakery.

The production waste per meal reduces with the increase in number of meal demand per day (Figure 1.9 & Figure 1.10). Demand uncertainty has significantly affected the increase of waste in the production area. Production uncertainty where the caterer has to take into account the risk of last minutes demand top-ups in advance and produce more than the initial order placed by the airline has created the supply chain bullwhip effect. Minimum waste per meal was achieved when the initial Meal Demand was 100% of the Flight.

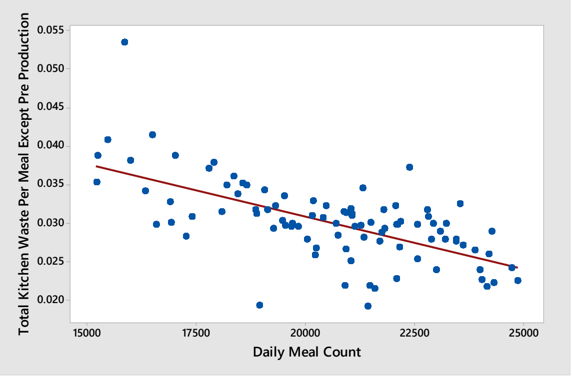


Figure 1.9: Scatterplot of Total Kitchen except Pre-Production Waste per Meal Vs Daily Meal Demand

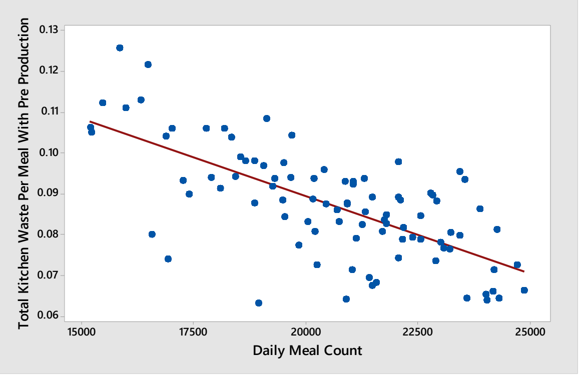


Figure 1.10: Scatterplot of Total Kitchen with Pre-Production Waste per Meal Vs Daily Meal Demand

CONCLUSION AND RECOMMENDATIONS

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 organizations. Furthermore, the airline catering industry is an area with minimal publicly available waste research. The present study aims to assess the food waste in sub production kitchens of an airline catering company, explore the relationship with the meal demand Fluctuations.There is a variation of the average daily waste in the flight catering company, Sri Lanka. Production of the flight kitchen are vary in terms of total meal demand, types of meals, airline classes, etc. The average daily kitchen waste per meal has fluctuated throughout the year.The average meal demands for all the classes of the airlines has increased (positive variance), represent that the risk of the increasing of the meal demands within last 24 hours has transferred to the caterer by the customer airline. Airline has not given a significant provision for potential meal demand increases when they place the initial order (initial meal demand) to the caterer. This creates production uncertainty whereas the caterer has to take the risk of last minutes top-ups in advance and produce more than the initial order placed by the airline creating the Supply chain bullwhip effect. If the top-ups not received the caterer has to bear the cost of over-production.Each month the pattern of the meal demand fluctuation with the week day number can be observed. Irrespective of the month the pattern of the average daily meal demand of the week day has continued over the period of the research.

There is a variation of the variability of the meal demand variance from customer airline to airline. Because of that the impact to the waste is varying, therefore I is necessary tp consider in costing and pricing. The variability of the passenger meal demand is less in the peak months for all the classes. The meal bank inventory levels should be adjusted according to the month of the year.The Passenger meal demand variability is high in short haul flights compared to the medium haul and the long haul flights. This need to consider when calculating the inventory levels of the meal bank with standard meals. All the independent variables are scientifically significant (P- Value < 0.05) for the average waste per meal in total kitchen except pre-production (vegetable room and butchery) indicating that the importance of focusing on meal demand forecasting in order to reduce the production waste.The highest absolute value coefficient (-0.01677) is incurred by the

EY- final meal demand, which the company need to focus and forecast efficiently in order to reduce the average waste per meal in total kitchen with pre-production.

The provision for the potential increases might cause the average waste per meal due to the uncertainty in the production line without accurate forecast for the final meal demand. The impact of the upstream in the supply chain can be seen that the waste has increased significantly in the Upstream (Pre- production) due to the Supply Chain bullwhip Effect.The company has to invest for a better Forecasting system or search for another options such as standard meals for the increases (meal bank), standard uplift with the agreement of the customer airline to uplift standard quantity of meals for each class (E.g.: business class 5 Nos. and economy class 10 Nos.) by charging a standard percentage (E.g. – Cost of the meals) if the actual meal demands not increased, if increased the normal price of the meals.

Based on the research findings the economy class meal demand has a significant impact on the production waste per meal, propose to commence the meal bank with economy class meals initially. The company should decide the percentage of meals for the meal bank based on the total daily economy class meal demand to cater the meal demand increases within 24 Hours. But this should agree with the customer airlines to provide standard meal for the increases within 24 Hours to the departure. The company should check the possibility of reducing the cycle time of the process by identifying the current bottlenecks such as blast chilling which consume approximately 4 to 6 hours of the total cycle time of the meal production. It is recommended to restructure the production process to operate with 24 hours of production cycle time to eliminate the uncertainty in the floor due to the non-availability of the passenger meal demands to plan the production accordingly. The company should adjust the strategies which are required to manage the over-ordered and over-produced food. One way to achieve this would be to create more standardization between customer menus, especially for economy meals which make up the majority of meals produced. More standardization between menus would give more opportunities for over-produced or over-ordered food to be utilized, decreasing the amount of food wasted.This Research allowed the flight catering companies to identify the importance of having accurate forecasting system to minimize the production waste.

FUTURE STUDY POTENTIALS

Based on the available literature, there are very limited research studies have carried out in the flight catering industry which is abillion dollar business with high risk and responsibility due to the nature of the industry. The researcher propose to further study the below areas in order to provide more information for decision making and improve the industry as a whole.

- Evaluate the financial and operational impact of the meal demand variance
- Evaluate the feasibility of different meal demands forecast systems and the financial and operational impact of implementing the systems
- Financial and operational feasibility of static and mobile meal bank
- Analyze the waste with categorization of the waste which will provide more information for decision making on waste reduction
- Analyze the customer agreements and their impact on the waste generation and the load factor uncertainty, and identify the agreements/ terms which has created a win-win situation for both customer airline and the flight caterer by improving the flight catering industry as a whole.

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Notes