Supply Chain Management in Airline Catering Service: Characteristics, Challenges and Trends

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Abstract

Supply chain management and logistics play an essential role in the airline catering business. The airlines' cost reduction strategies have recently shifted the focus from culinary aspects to supply chain management. This research aims to understand the unique characteristics, operational challenges and emerging trends of the airline catering supply chain. This research paper has chosen an exploratory and qualitative method based on an analysis of the current literature within supply chain management in the airline catering service. In addition, the findings from the case study presented in this paper are used to reveal more facts and add to the existing body of knowledge. An analysis was conducted by applying the five forces business analysis model proposed by Michael Porter to demonstrate the industry structure and identify the value of effective supply chain management in the airline catering industry. In addition, an empirical study of the airline catering service strategy of an airline catering organisation in the U.K. has been presented. Furthermore, a representation of the airline catering supply chain characteristics has been demonstrated with the processes of the SCOR model. Also, this paper seeks to understand the operational challenges and examines the emerging trends in the airline catering supply chain. Finally, the study concludes that supply chain management can offer enormous potential to improve service effectiveness and add economic value for airline catering industries.

Keywords
Airline Catering, Supply Chain Management, Logistics, Inflight products, SCOR, Sustainability.

1. Introduction
The onboard dining experience is an essential attribute for airline passengers' satisfaction. Airlines are making a great effort to improve the quality of their in-flight food and drinks services. The airline catering business is rapidly evolving, and the organisations in this industry have to operate in a demanding and time-sensitive business environment (Jones, 2004). They need to be effective and innovative in their catering services to maintain and improve their competitive position. The nature of airline catering service has changed with the ever-changing aspects of aircraft capacity to satisfy the requirements of carrying more passengers to the destinations. As the aircraft size and the capacity growth, the onboard galley areas become smaller. An essential consideration for the airline catering product design is weight distribution to fuel ratio. In current days, onboard logistics, weight and cost determine the inflight meal concept. Effective supply chain management is a key aspect of the airline's ability to provide their passengers with a high-quality dining experience onboard (Sundarakani, Abdul Razzak and Manikandan, 2018). But it has always been challenging for airline catering companies to manage the large volume of meals from the kitchen to aircraft and the reverse flow of equipment and unused items in a very complex environment (Kumar, Sharma and Agarwal, 2015). As a general observation, they seem to be inefficient and uneconomical. The level of developments in the airline catering supply chain can facilitate or constrain the economic performance of the airline industry. Therefore, various aspects of airline catering supply chains need to be explored in the growing market with its own distinctiveness. The research in this paper was to recognise the unique characteristics of supply chain management in the airline catering industry, understand the service strategy, highlight the operational challenges, and examine the emerging trends from the airline catering industry. For this research, we studied existing literature about airline catering and interviewed the supply chain professionals from one large airline catering organisation in the U.K. The below diagram in Figure 1 shows the three stages of analysis and the research framework used in this study.
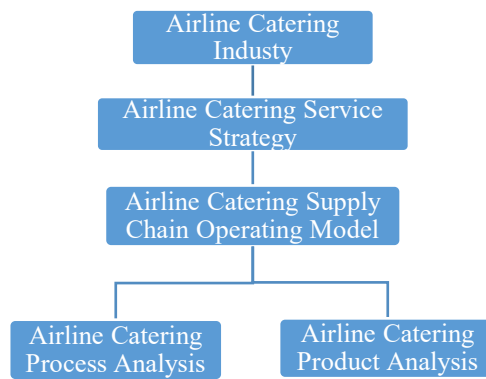
Figure 1. Research framework and structure

Following this brief introduction, this paper analyses the competitive industry structure of the airline catering business in section 2. Then in section 3, It discusses the airline catering service strategy based on the findings of the case study organisation. Section 4 highlights the characteristics of the airline catering supply chain. Section 5 covers operational challenges and emerging trends in airline catering supply chains. Concluding remarks and future directions for the research are discussed in the last section.

2. Airline Catering Industry

The meal on board may seem to come from a single party (the airline). This isn't as trivial as it may seem; it's the result of much more widespread origins with multiple interactions between multiple stakeholders in the airline catering supply chains such as governments, airlines, logistics service providers, caterers, meal suppliers, and passengers (Lin, 2018). Such elaborate coordination shows the complexity of operations in the airline catering sector, where organisational principles such as outsourcing, vertical integration and just-in-time assembly are just as important. The typical relationship between stakeholders in the airline catering industry is shown in Figure 2. In recent times, many businesses are discovering emerging markets in the airline catering industry. This trend has influenced more and more airlines to contract the catering service out to catering companies while some airlines are still operating their own catering units. The length of catering contracts between the airline and service providers is usually three years agreement (Chang and Jones, 2007). Some contracts are signed for a more extended period.
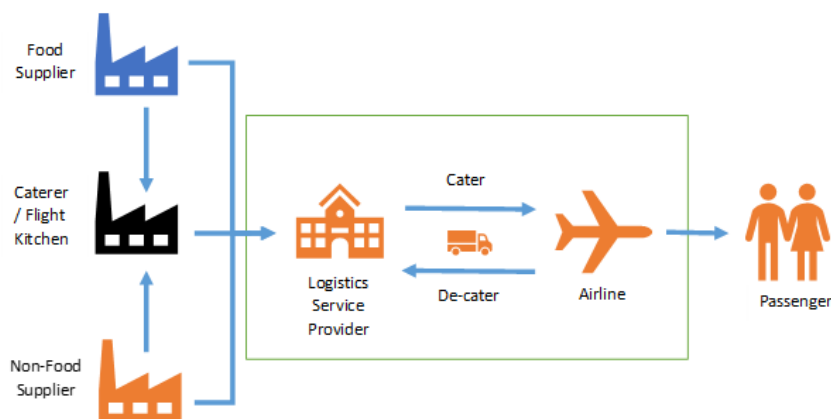

Figure 2. Stakeholder relationship in airline catering (Rajaratnam and Sunmola, 2020)

There has been increased competition in the airline catering industry due to the advancements in the industry. Due to the cost pressure, most airlines decided to outsource their catering service. Some catering companies subcontract the meal production and remains in the industry as the logistics service provider (Rajaratnam and Sunmola, 2020). As

outsourcing become a trendy option in the airline catering business, it influences logistics companies to expand their service into the new market, the airline catering supply chain. Industry structure and competition are a few key issues that might affect the airline catering industry, with other operational challenges mentioned in the later section of this paper (Jones, 2004). The competitiveness of the airline catering business environment has been examined by applying Porter's five forces model. The summary of analysis findings are listed in Table 1 below.

Table 1. Porter's five forces in airline catering industry

Force	Power
Threat of New Entry	Low
Rivalry	High
Threat of Substitution	Low
Power of Suppliers	Low
Power of Customers	High

Threat of New Entrants
The threat from new entrants is low as companies need significant financial investment to establish themselves in the airline catering market. High market saturation is another factor that prevents companies from entering the airline catering business (King, 2001). The company's location is an issue as flight kitchens, and assembly centres need to be located near the airports. Finding a premium location in such a popular area is difficult, and the cost of the space will also be high (Jones, 2007). For newcomers, it's becoming more and more challenging to achieve the cost advantages and to compete with large catering companies in this industry where fewer parties control the airline catering supply chain. All these barriers can lower the threat of entries.

Rivalry Among Competitors
The airline catering market is very competitive since many large and well-known catering service providers operate in the airline catering business sector. The main competitors compete over gourmet menu designs, catering costs, quality standards, and service performance to remain competitive in the market and to attract new airline customers (Sundarakani, Abdul Razzak and Manikandan, 2018). The cost of building, equipments, and aircraft catering trucks for providing catering services is high in this industry. And finally, the high financial penalties or losses may occur as a result of ceasing catering services. Although the airline catering industry growth is fast (Transport, 2018), other factors mentioned here, making the level of competition more intense.

Threat of Substitute Products or Services
Threat of substitution in the airline catering industry is low. Inflight catering services impact overall passengers travel experience, and there is no direct substitute for inflight meals (King, 2001). The low-cost carriers and few other large airlines have stopped their complimentary meals and snacks service onboard for economy class passengers in short-haul operations. Some alternatives such as buy-on-board meals, preorder meals have now been introduced instead (Jones, 2012). Though these alternative services may impact traditional airline catering, they do not pose any serious threat to airline catering companies' sustainability.

Bargaining Power of Buyers
The bargaining power of the buyers is relatively high in the airline catering industry since buyers are more concentrated than sellers (King, 2001). There are few airlines and many caterers within a region. Airlines are price sensitive and are well educated regarding inflight products and catering services. Airlines face cost-cutting, their profit margin is low. Hence there's pressure for low costs (Eksi, Soyer and Onar, 2012). Airlines have their own experts working with catering companies to design the menu plans and meal specifications. They have more influence in the development of catering services. Also, Airlines purchase a high volume of meals (Mitro, 1998). Additionally, In the airline catering service, the quality of the meal is paramount. The inflight catering service will have an impact on airline's prestige and passengers experience(Eksi, Soyer and Onar, 2012). All the above factors indicate that airline customers power is high.

Bargaining Power of Suppliers
Airline catering companies purchase food and non-food items from multiple suppliers. They have an engaging relationship with the local network of suppliers, often calling tenders and negotiating a lower price based on large

volume purchases for their airline catering production (Lin, 2018). Most of this food, non-food items that caterers purchase are undifferentiated, and substitutes are readily available for them in the market. Caterers can select the suppliers who provide a high quality of products for a low price. Catering companies have clear legal clauses against supplier delays. They put high emphasis on punctuality in their contract with suppliers and will charge penalties for late deliveries and also reserve the privileges to find an alternative supplier in the event of delivery failures (Lin, 2018). Therefore, the bargaining power of suppliers is relatively low in the airline catering industry due to these factors.

According to Michael Porter's five forces of competitive position analysis, an industry is attractive when the power of all the forces are low collectively. As per the above aspects of the industry's competitive structure, we can conclude that the airline catering industry shows some attractiveness. There are some opportunities for better performance in this sector. Figure 3 presents the graphical illustration of the characteristics of competitive forces in the airline catering industry.
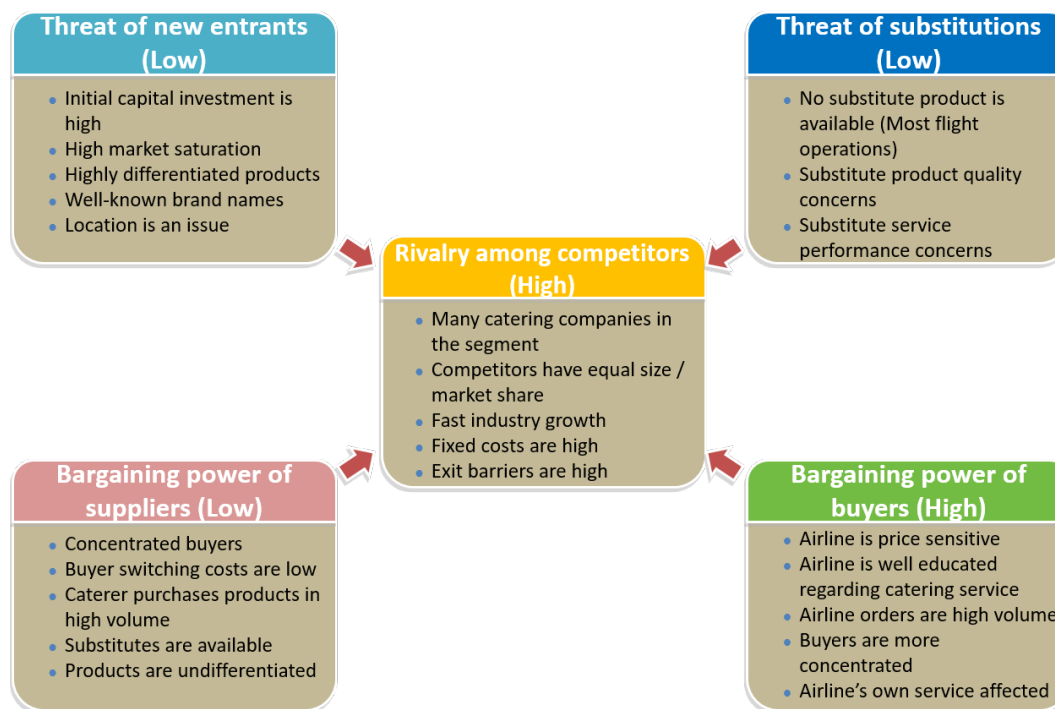
Threat of new entrants (Low)
- Initial capital investment is high
- High market saturation
- Highly differentiated products
- Well-known brand names
- Location is an issue

Threat of substitutions (Low)
- No substitute product is available (Most flight operations)
- Substitute product quality concerns
- Substitute service performance concerns

Rivalry among competitors (High)
- Many catering companies in the segment
- Competitors have equal size / market share
- Fast industry growth
- Fixed costs are high
- Exit barriers are high

Bargaining power of suppliers (Low)
- Concentrated buyers
- Buyer switching costs are low
- Caterer purchases products in high volume
- Substitutes are available
- Products are undifferentiated

Bargaining power of buyers (High)
- Airline is price sensitive
- Airline is well educated regarding catering service
- Airline orders are high volume
- Buyers are more concentrated
- Airline's own service affected

Figure 3. Porter's five forces analysis for the airline catering industry

3. Airline Catering Service Strategy

An airline catering organisation's success depends on a steadily maintaining high quality of service within ever shorter times. Therefore, flexibility and perfection are the most critical airline catering organisations' service objectives to enhance their competitive position in this segment (Szymanski, 1995). Airline catering, being engaged in the food supply chain for ever-changing and demanding airline operations, raises this logistics position to another level. The airline catering supply chains not only have to meet the requirements for food production but also the specific conditions of airline operations, including the flight time, length of travel, class designations, destination of the flight, route sector, the aircraft type, storage limitations, serving conditions, passenger's dietary needs and preferences (Jones, 2012). Moreover, the changes like passenger movements, flight schedule changes and aircraft change happening in the airline business in real time. Therefore, catering service providers need to decide on an immediate response within a short time frame for a quicker catering service delivered to the airline. Airlines decide on their service strategy. The airline catering organisation must be clear about the airline catering service strategy. An airline catering organisation requires to keep the meal costs as low as possible and still offers a certain level of product quality.
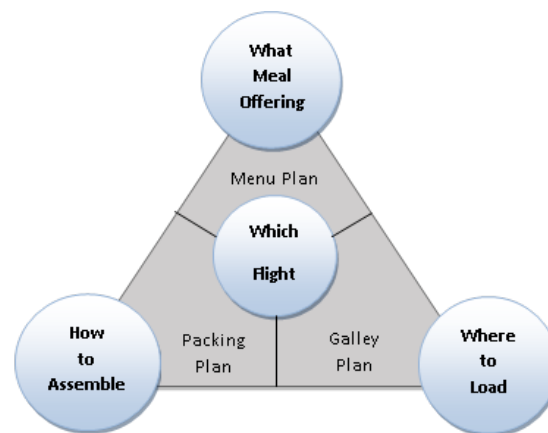
Figure 4. Airline catering service strategy

Figure 4 above illustrates the airline catering service strategy. It defines a flight's catering requirements, including meal-offering, packing information, and stowage position details. Caterers have access to the relevant guides and service documents defined by the airline. The menu plan contains information such as type of meal-offering, rules and specification of the menu explaining the specific elements of different inflight products and services. The packing plan is the overall guide to the assembly activities that describe how the meals and other catering products should be packed in the catering containers. The galley plan provides the aircraft galley's layout and outlines the stowage position details that tell where to load the various catering containers in the aircraft.

A great customer experience is based on an excellent service experience. According to the service level expectations, airline catering service providers don't just plan the menu, but also the inflight product and all the services and all it'll take to deliver the passengers onboard to that particular flight and delight them. Caterers assemble meals, tray sets, and catering containers as per the daily flight schedule to provide the catering service. Airline companies will engage with the caterers throughout the airline catering order fulfilment process. They usually give the forecast of passenger numbers and meals to the caterers in advance for catering service. Then the final numbers will be confirmed via electronic messages or telephone to the service providers 4 to 6 hours prior to the flight's departure. Between the initial forecast and the final order confirmation, catering service providers will be updated with the changes periodically. Upon completing the service, the catering organisation could also be required to perform post-order processes such as invoicing by flight, respond to passengers complaints, cabin crew feedback and other general enquiries.

4. Supply Chain in the Airline Catering Industry
This research analyses the characteristics of supply chain operations in airline catering according to two fundamental building blocks of the airline catering operations: processes and products perspective.

4.1 Airline Catering Supply Chain Operating Model – Process Analysis
In a typical airline catering operation, airline will provide the forecasted passenger numbers on a particular flight in advance. Then It'll inform the catering service provider with regular updates. To fulfil the airline order from the customer, the catering service provider will take series of process steps to produce the catering container with meal tray set, ancillaries, main meal, non-food items. These packed containers will be transported to the airside using the special catering truck. These trucks can be elevated up and down, and the stage can be moved to the same level as the aircraft door for the catering trolleys to be able to load and unload easily. These sealed containers will be stored securely in the designated areas of the aircraft galley. The cabin crew will then serve these meals to the onboard passengers at the defined time during the journey. On arrival, all the catering containers, equipments and catering waste will be collected from the return flights and transported back to the service centre. Catering waste will go through the waste management process. Containers and equipment will be washed and kept ready for reuse. In achieving effective airline order fulfilment, it's essential to manage complex supply chains, apply the catering logistics principles and leverage the advanced supply chain systems and technology (Rajaratnam and Sunmola, 2020a).
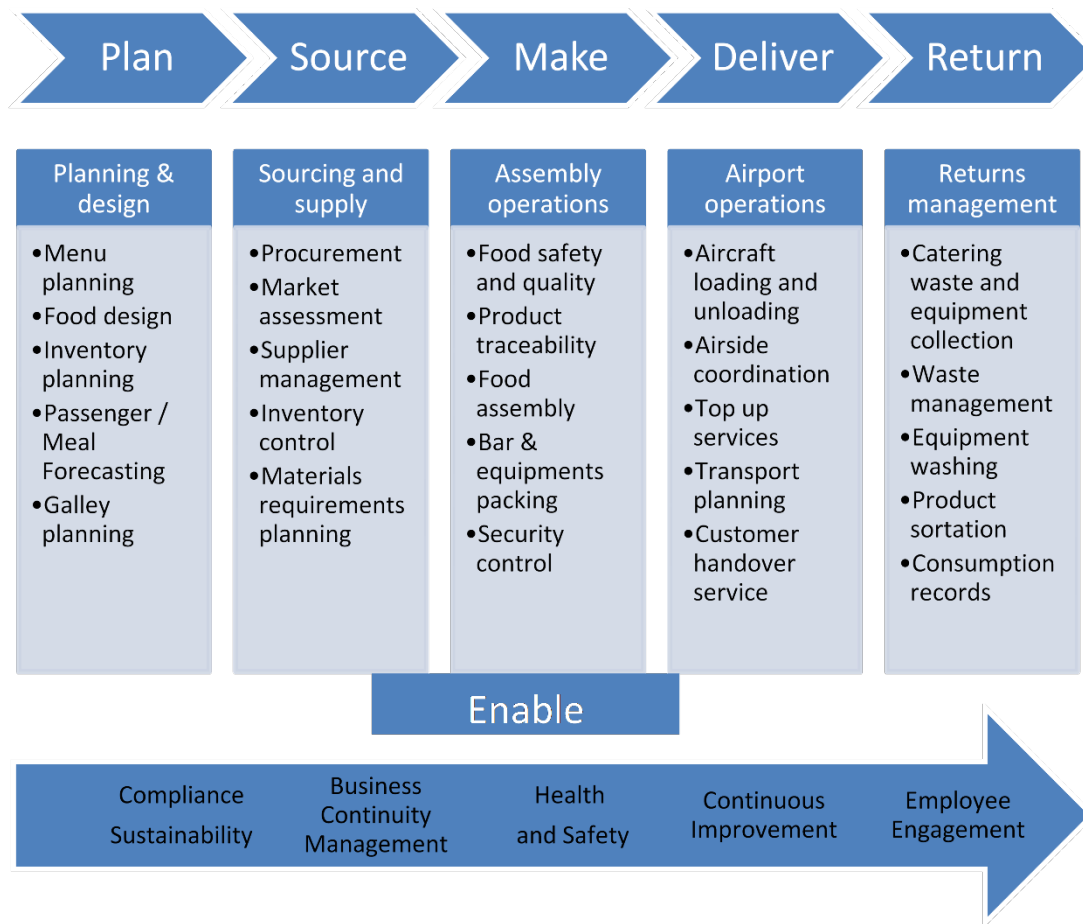
Figure 5. Supply chain process in airline catering

SCOR model has been used to analyse the processes of the airline catering supply chain. Figure 5 above shows the supply chain processes in airline catering operations. The process perspective of the airline catering supply chain operating model is defined around six primary management processes in the SCOR framework: Plan, Source, Make, Deliver, Return, and Enable (Delipinar and Kocaoglu, 2016).

One of the critical activities in the plan process of the airline catering supply chain is menu planning. Airlines and caterers work together to meet the needs of onboard passengers. The other essential activity involves in this process is galley stowage planning. This has a significant influence on the design of inflight catering product specifications and menu planning. The source management process includes the procurement activities of all components required for airline catering production, supplier management and inventory functions. The catering organisation must have an engaging work relationship with many external suppliers to find the right products; both customers nominated products and sourced products to meet the airline expectations.

The case study organisation has subcontracted the meal production activities. In the above SCOR based model, the make process represents a specific type of materials conversion, which is the assembly operation. This process takes one or more items as input and generates one or different items as output. In the example of the meal tray set assembly process, it consumes the main meal and various tray set components (jam, milk gigger, water couplet, salad and dessert). It then produces a complete tray set unit such as hot breakfast tray set, hot meal tray set or cabin/tech crew meal set. Flight schedule determines the production plan for the availability of inflight products and services (Hovora, 2001). The deliver process includes the management of airline catering orders and the transportation of the catering

containers to the flights. It also covers scheduling outbound delivery, picking, preparing catering containers for shipping, the goods issue process and creating billing documents.

Airline catering service providers are also responsible for the return logistics. They need to manage the reverse flow of the catering equipments and the catering waste from the return service flights. Catering waste are caused by the inflight meals, beverages and snacks that are served to the onboard passengers. They are made up of leftover food, packaging materials and excess drinks. Catering waste will go through the waste management process. Containers and equipment will be washed and kept ready for reuse. The enable process defines all the activities related to the management of the airline catering supply chain. Despite the growth in airline passenger numbers, Airlines are struggling to maintain profit margins. Airlines must manage other operational costs, such as catering service costs, more efficiently to maintain sustainable airline operations. Airline catering organisations need to become more efficient in catering operations. Hence more focus is required on enable process.

4.2 Airline Catering Supply Chain Operating Model - Product Analysis

Airline catering companies engage in mass customisation as they need to produce a high volume of meals with great variety every day. They need to make changes to inflight products and catering services to satisfy airline customer and their passengers. These inflight products are highly differentiated between airlines, different cabin classes, and time range (Chang and Jones, 2007). The mass customisation enables airline catering companies to produce a wide choice of inflight products in large volumes by following a range of airline catering instructions, catering procedures, menu profiles and meal specifications in relation to the airline catering supply chain, service design, and airline catering order fulfilment processes.

Airline passengers have more preference now than ever before. There's an increasing trend in special meal orders and reduced standard meals due to passengers becoming more health-conscious, food allergies, or religious reasons. These special meals are highly differentiated and need to be prepared according to various dietary laws and religious considerations. Airline catering service needs to deal with a wide range of products. Most of the catering service providers have contracts with more than one airline for providing catering services. Therefore, there is a wide variety of products deriving from multiple factors within the airline catering business. These influencing factors are presented in Table 2 below.

Table 2. Factors of Inflight product and service varieties

Factors	Variabilities
Airline catering contract	Single airline / Multiple airlines
Type of flight operation	Standard scheduled flight, Chartered flight, Low-cost carrier, Executive airline
Flight duration	Domestic flight, Short-haul flight, Mid-haul flight, Long-haul flight
Cabin class	Economy, Premium economy, Business class, First class
Meal type / Time range	Breakfast, Extended Breakfast, Lunch, Afternoon, Dinner, Supper
Passenger's preference	Preorder meals, Special meals (E.g. Vegetarian, Vegan, Kosher, Halal, Low-fat, Low-salt)
Menu cycle	Daily rotation, Weekly rotation, Monthly rotation

In the aggressive cost-cutting approach, airlines are increasing pressure on catering service providers to execute their supply chain more cost-efficient and agile (Eksi, Soyer and Onar, 2012). Catering organisations are encouraged to make their production more flexible (Gschirr, 2010), including prefabricated frozen food that can be stored and catered to the flights as per the demand (Lin, 2018). Due to the high degree of customisation in airline catering products and services, and also the airline catering orders need to be fulfilled relatively faster, airline catering should have a responsive supply chain.
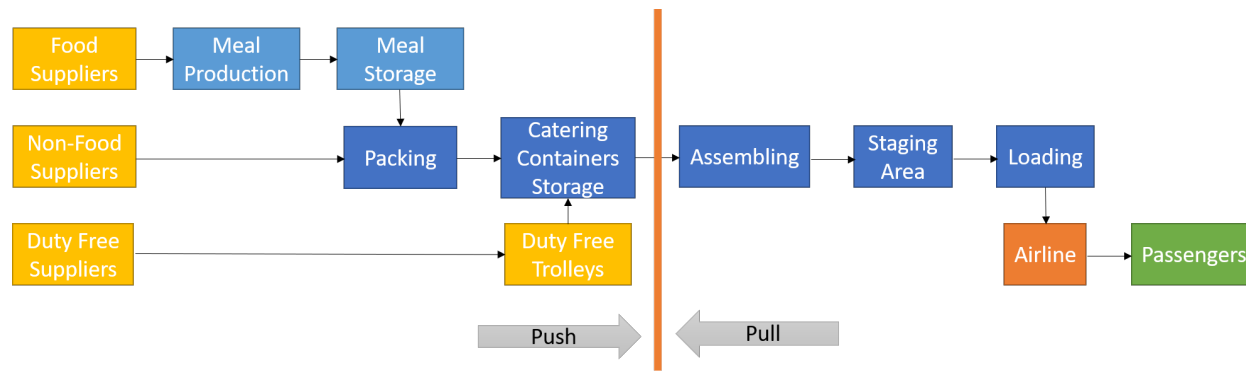
Figure 6. Airline catering supply chain: Assemble-to-Order (ATO)

Figure 6 shows the Assemble-To-Order (ATO) supply chain design which is more appropriate for more customisable and quickly fulfilled customer orders like airline catering orders. At present, the airline catering organisation where the study has been conducted has an ATO SC design where the components of the inflight products are assembled in the flight assembly centre after the airline order is received according to the appropriate catering specifications. It reduces the inventory of catering containers required and delivers the catering shipment to the aircraft quickly. In this airline catering environment, components are procured well before the catering order arrives. Some meals are already produced based on the latest forecast and ready to be assembled based on the specific catering requirements.

5. Supply Chain Challenges and Trends in Airline Catering Industry

5.1 Challenges
Some of the critical challenges in the airline catering supply chain are – growth of passenger traffic, cost pressure, airline disruptions, food safety, aviation security, and sustainability. Passenger traffic has usually increased year on year and ready to stay in this rising trend. According to an analysis done by IATA (International Air Transport Association), the number of airline passengers could double up and reach 8.2 billion in 2037 (IATA, 2018). Despite the growth in airline passenger numbers, Airlines are struggling to maintain profit margins. The airline industry has realised a continuous increase in revenue over the last decade. However, their profitability is not significant and has always been volatile. This is primarily because of the competition with low-cost airlines (Sundarakani, Abdul Razzak and Manikandan, 2018) and due to an increase in fuel prices. To maintain the sustainable airline operations, airlines are required to manage other operational costs, such as catering service cost more efficiently (Oktal and Oktal, 2009). Catering providers and suppliers need to become more effective in catering operations. Existing legacy processes are one of the factors causing additional cost and complexity. Reviewing the end-to-end process may provide the opportunity to save costs and enhance the value proposition for the customer. The ability to manage airline disruptions is another challenge in the airline catering supply chain. Airline catering service providers need to support airlines to deal with disruption events. To facilitate performance improvement in the airline catering supply chain, it's essential to learn lessons from historical events to deal with major disruptions due to heavy snow, volcanic ash, terrorism and security threat, and pandemic. These events result in flight cancellations and airport closures which affects airlines and passengers.

The next key challenge is food safety. Airline catering service providers need to work in ensuring not only food safety but also the flight safety. Food quality provision for tech crew and cabin crew, passengers and crew exposure to the undeclared allergens in onboard meals, possible risk of terrorist activities through food and water supply, and non-traceability of food waste and products in catering supply chain are some airline catering related provisions that may impact on airline operations and constitutes aviation safety (Jones, 2004). The development of catering products is progressing so quickly, and there are also challenges in keeping the standards for food safety management that are robust enough. To ensure the food safety, effective interaction between the catering service provider and cabin crew is required. The cabin crew should be aware of the type of inflight meal service and check it against the catering requirements. The crew also needed to check the correct stowage position, with the catering container sealed and protected from any hazards such as dust, temperature, and bugs. Airline catering service providers need to ensure that the safety protocol is considered in every stage of the supply chain process from beginning to end. It's required to

establish necessary standards for food, non-food materials procurement, goods receipt, production and assembly process, labelling activity, and despatch process. The other major issue that affects the industry is security. The evolving nature of terrorism threats and the airline industry remain their attractive target enforces aviation authorities to implement more restrictions and security rules. Caterers may deal with airport security issues when they transport catering containers and must meet the security regulations throughout the logistics process (Jones, 2004). This additional burden has become a challenge for catering companies whose actual priority has been food safety and the quality of delicious meals. However, it may not be too difficult for logistics service companies to comply with such security standards. They are already familiar with DFT (department for transport) operating standards and practices.

International tourism relies on air travel. The unprecedented growth in the tourism industry has created the waste problem in the airline industry. The growing passenger numbers, increased number of flight operations, and new types of commercial aircraft altogether contribute to the formation of solid waste. Therefore, waste management becomes a key issue for airport operations and is a challenge consistently faced by the airline catering industry. For example, waste from Heathrow airport operations is estimated at 25,000 to 40,000 tons per year, 70% of which through catering (Thamagasorn and Pharino, 2019). With most of the waste generated from catering services, sustainability concerns are becoming significant challenges in the airline catering supply chain (King, 2001). There are around 630 flight kitchens globally, and each kitchen supply more than one million meals per year (Chang and Jones, 2007). The meal is generally considered as the low-cost resource in airline catering service. Food waste is mainly caused by overproduction and catering to avoid any meal shortages. Meal production depends on the airline catering orders that frequently change due to passenger numbers drop or other uncontrollable factors such as flight cancellations and delays. But, it poses a significant sustainability problem because of losing precious calories and degradation of soil fertility, additional energy and water consumption in food production, and increasing waste management costs for governments. Current practices in the airline catering supply chain need to be reviewed, and required changes must be implemented to reduce the sustainability issue.

5.2 Trends
In this section, we discuss some key emerging trends – outsourcing, digitalisation, automation, food preordering, supply chain visibility, agility and sustainability management which are likely to affect the functioning of the airline catering supply chain.

Outsourcing of airline catering services is an increasingly popular practice in the airline industry as it helps airlines cut their catring operations costs and serve better quality meals. This growing trend has emerged in the airline catering industry as well. The catering companies are becoming more as catering logistics partners for airlines than catering providers, partly due to the large outsourcing volume of finished products. There are specific catering logistics companies that accomplish this function exclusively. This relatively new concept is based on the principle traditionally including logistics and food production under the same roof in airline catering organisations, are now completely divided. This means that the airline catering organisations perform the catering service's logistics aspects but outsource all food products and components from food suppliers and manufacturers.

As cost savings become increasingly important, airline catering service providers are also finding new ways to reduce catering costs. Few catering companies already adopted robotic technologies to support their meal production. This innovative digitalisation will increase the flexibility of their catering service while reducing operational costs. Few airlines have invested in new digital technologies such as computer vision and machine learning to minimise their catering wastage on their flights. The innovative solution aims to track leftover meals from the flight after arrival. It will identify meal types and quantities of meals that are not consumed or untouched using artificial intelligence (AI) and image recognition without manual intervention. Data analytics technology will reveal the consumption trends and wastage patterns across their flight operation using the collected data, help manage food waste efficiently, improve forecasting and meal ordering, and reduce catering costs. The current competition is accelerating automation in the airline catering industry. Warehouse conveyor systems are being used in warehouse and assembly operations to assemble meals and catering containers (Szymanski, 1995). In the catering equipment was-up area, advanced machines handle the vast volume of washing-up daily, including processing plates, dishes, fragile glasses, cutleries, and trolleys.

Some airlines have started collaborating with online meal ordering and delivery service companies to enable passengers to enjoy their preferred meals on board. For example, the partnership between airlines and online food ordering companies like Just Eat takeaway.com allows passengers to place the meal order of their choice for their

travel via an online platform upto one hour before departure. Online food delivery service company will directly deliver the freshly prepared meals to the flight, and cabin crew will serve them to the right passengers. This innovative catering service also makes it possible to reduce food waste by avoiding the large number of meals being prepared and loaded onto the aircraft but not consumed by the passengers.

Airline needs the real-time visibility. Supply chain visibility in airline catering is required to take the next step forward, leveraging the real-time data integration end to end. Airline catering organisations must focus on integrating IT systems and business processes to improve their internal logistics to increase operational transparency (Mitro, 1998). Customers need to know the overall airline catering supply chain, especially the real-time view of the logistics; where the meal sets are, where they are being prepared, where they are being assembled, and what's the quality of meals, Are service providers meeting airline customer's SLAs, and so many other key metrics. Without relevant management information, it's hard to make decisions and difficult for effective control in managing catering logistics and the supply chain cost. This can lead to inefficient airline catering operations, a high inventory of expensive stock and the inability to eliminate the non-value-added costs from the airline catering logistics process. An integrated logistics system is needed to ensure that this visibility tightly connected to the logistics execution. From the visibility, airlines can make better decisions, caterers can take direct action, and can change their logistics functions to meet the airline's needs. Supply chains are moving from the linear model to agile principles. Stakeholders in the airline catering supply chain are trying to implement new strategies to achieve agility (Law, 2011). The airline catering business demands more and more innovation. Airlines want to introduce new catering products and services. The airline market is more competitive today than it was before. The responsive time needs to go down. Ultimately, the airline catering supply chain and logistics service need to be as agile as airlines can think of new innovative ideas and business models (Ivanovic and Vujic, 2007).

Reducing waste is one of the critical sustainability strategies for airlines (Jones, 2012). Airlines have started effective recycling of food and using environmentally friendly packaging with the support of systems and technologies. While this initiate avoids landfilling, it also provides a new source of revenue stream for airlines. Single-use plastics contribute to catering waste. Catering service providers introduce sustainable alternative packagings and recycling solutions to reduce the waste. They can eliminate plastic waste by sourcing biodegradable cutleries and cups. Airlines are needed to comply with the industry's commitment to reducing CO2 emissions. To support this, airlines are keen to implement carbon reduction projects and initiatives. This includes operating more fuel-efficient aircraft, catering waste management and reducing catering load. Prevention of catering waste is the most preferred method, and disposal is the least preferred method in the catering waste management hierarchy. Implementing good supply chain practices to control catering waste prevention and the reduction will reduce the amount of waste that reach landfills through disposal. This include supplier management, inventory management, good menu planning, appropriate workflow design and required training (Thamagasorn and Pharino, 2019). Reverse logistics must implement proper catering waste management to reduce the environmental impact. They collaborate with recycling companies to transform biofuel from organic catering waste instead of traditional waste disposal methods as food waste that ends up in landfills or oceans creates additional environmental burdens. Its organic contents are easily biodegradable and generate greenhouse gases such as carbon dioxide (CO2) and methane (CH4) in the atmosphere (Mahmood, Parshetti and Balasubramanian, 2016). In addition to addressing the environmental concerns, Airlines becoming more focused on corporate social responsibilities (CSR). Catering service providers help airlines make charitable donations through partnerships with other aid organisations or airline's own charity foundations to support communities. A catering company can partner with airlines to take CSR initiatives by donating excess foods to charities as they recover quite many untouched meals such as packed snacks, biscuits, unopened drinks, pre-packaged sandwiches and bakery products from return flights.

6. Conclusion

The main objectives of this research were to understand the advancements in supply chain management in the airline catering industry, to analyse the suitable supply chain for catering service, to present the challenges and trends in the airline catering supply chain, and to demonstrate that supply chain management as a strategic function can add economic values to both caterers and the airlines. Effective supply chain management enables huge reduction of costs by developing inflight products and implement service strategy with airlines, caterers, and suppliers, securing the airlines' competitive prices. Offering a complete supply chain solution, catering service providers provide the right inflight products at the right time to the right aircraft at the right condition at the right cost, which is the ultimate objective in the airline catering supply chain.

Analysis of market structure and competitive situation suggest that the airline catering industry is attractive in emerging markets. Case study findings recognise the Assemble-To-Order (ATO) supply chain design is suitable for airline catering business that engages in mass customisation and requires a responsive supply chain. The research also highlights some operational challenges such as the growth of passenger traffic, cost pressure, airline disruption, food safety, aviation security, and sustainability which affect the airline catering industry. It discusses some emerging trends like outsourcing, digitalisation, automation, meal preordering, supply chain visibility and agility in the airline catering industry. The limitation of this research is that some findings are from deep observation of a single case study. Some responses could be biased, may not truly reflect the view of the entire industry. This research can be further extended to examine multiple case studies in different size airline catering organisations in different regions to analyse the global airline catering supply chain. Future investigations can also include more quantitative analysis to compare their competitive structure, positioning and suitable supply chain design according to different business models geographically. This paper contributes to both the literature in airline catering operations and the supply chain management literature by recognising some critical research areas related to both fields. Furthermore, this study helps academic researchers and business leaders better understand the complexity of supply chain management in the airline catering service and concludes that airline catering organisations should consider supply chain management as a strategic function that offers enormous potential for improving service effectiveness and adding economic value for airline catering industries.

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