Air Cargo Revenue Management

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The airline industry, with its high start-up costs, low profit margins, and rapidly changing competitive environment, has traditionally been a fertile ground for OR. One of the most recent and high-profile OR success stories in airline OR in recent years has been Revenue Management (RM) – formal modelling approaches and systems which seek to determine the optimal price and point in time at which to release a highly perishable product (such as an airline seat) into the market place.

RM has come a long way since its origins, at American and other airlines around the world. Now, there is no major international passenger airline without a Revenue Management System (RMS) of some sort, and a team of OR practitioners to oversee it. Simply put, the incremental revenue directly attributable to RM is generally believed to much more than offset the associated costs of RM implementation.

The concept behind an RMS is, at the highest level, quite simple. As everyone knows, airplane seats tend to go up in price as the day of flight departure approaches, and prices received from different channels (e.g. travel agents, bucket shops, and the airline's own webpage) may vary widely. The reason for this is that airlines are trying to achieve two contradictory objectives: to fill up their flights (every empty airline seat is a revenue opportunity forever lost) and to capture the high-value business travelers, who typically travel on short notice and are relatively price-insensitive. An RMS, by tracking demand and determining the optimal level of price and capacity control, can help seat controllers decide when and at what price to release seats into the market.

To date, however, RM has been overwhelmingly applied to the management of passenger, rather than cargo, traffic. It may seem surprising that airlines should have neglected the application of RM to air cargo. However, historically, air cargo has been viewed within airlines as a sideline to the more glamorous passenger business: even in major international carriers, for whom air cargo represents a significant percentage of their revenue stream, the air cargo business has gone undermanaged and underanalysed. With increased competition and rapidly growing demand in the air cargo arena, however, this is set to change, and there is growing interest in air cargo RMS amongst both airlines and system vendors.

As it turns out, passenger RMS cannot be easily transferred to air cargo, as there are a number of significant differences between the two businesses. For example:

1. In many airlines, air cargo space is allocated out as much as six months in advance to freight forwarders, whereas passenger seats are held by the airline until such time as a passenger makes a purchase.

2. Cargo capacity which is carried in the bellyhold space of wide-bodied passenger aircraft is normally only known probabilistically in advance: the cargo that is available at time of flight departure will depend on the space left after passenger baggage is loaded.

3. Booking documentation and practices vary between the two businesses. From the computer records, it can be hard to piece together a transit passenger's journey and get an accurate picture of his itinerary from beginning to end - especially if, as is becoming increasingly common, his journey involved multiple airlines. Cargo, on the other hand, is booked through only once, from origin to destination. On the other hand, passengers tend to book further in advance than cargo, and so data is available for analysis and forecasting much earlier.

4. Cargo is bi-dimensional, having both weight and volume, and can vary widely in both these dimensions. Moreover, there are constraints on how cargo can be loaded into the airplane. For passengers on the other hand, a single passenger will always take a single seat.

Cargo RMS's are designed to meet support these distinctive needs of the cargo business.

Although cargo RMS are evolving, some broad structural features are becoming clear. A cargo RMS will typically have two parts: an allocation part, which will help airlines perform the long term allocation described in 1. above, and a part for managing the remainder of the capacity (for ad hoc or "freesale"). Normally airlines manage the allocation as an auction - "bids" for space are solicited from stations and the revenue management system allocates on the basis of the bids. To manage free-sale capacity, on the other hand, requires a system more akin to passenger revenue management systems, which monitor booking behaviour and forecast and re-optimise on that basis.

As well as differing at the level of broad structure, the details of the forecasting model also differ. Most notably, because of 2. above, there is a need to forecast cargo capacity as well as forecasting demand. But the differences in booking practices mentioned in 3. also surface here, since, as a result, the available data differs between the two businesses. It is relative easy to forecast cargo from origin to destination; it is relatively hard to forecast passengers in this way. On the other hand, it is easier to make a confident forecast a week ahead of time of the load on a passenger flight, as most passengers will already have booked: with cargo, the picture is much less certain.

These differences in forecasting also propagate to the level of the optimisation. The optimisation problem itself is quite different in the case of cargo. For a start, there is bi-dimensional nature of cargo mentioned above in point 4.: clearly this affects the optimisation problem as it means that there are two sets of capacity constraints, rather than just one. But another, more significant difference stem from the greater availability of origin-destination demand data and forecasts mentioned in the previous paragraph. This makes it easier to do "network optimisation", as opposed to "leg optimisation". In a leg optimisation

world, you may decide to reject a shipment on the busy Penang to Singapore flight, on the grounds that its revenue for that flight leg is inadequate; in a network optimisation world you may decide to accept it on the grounds that it will connect to the empty Singapore to Tokyo flight, and its net contribution to the airline will outweight the displacement of local traffic from Penang to Singapore.

In this paper I have concentrated on cargo revenue management, but I hope this paper will have whetted the audience's interest in RM more generally. RM is potentially applicable in a whole range of industries – car rental, hospitality, rail transportation, energy and broadcasting, to take a few examples. As I have tried to demonstrate, RM is a challenging and stimulating area of OR – and, moreover, an area where the OR practitioner can have a direct and substantial impact on his company's revenue performance and bottom line profitability.