Information technology can dramatically improve an airline's performance. If the incorrect system is used the airline will suffer inefficiency and high cost. Now more than ever airlines must be selective in the systems they use. This survey highlights the systems available for all major processes.

IT systems for revenue generation

Airline information technology (IT) can be a confusing and contradictory area, especially IT relating to revenue and yield management, ticket distribution and market intelligence. The market has many IT suppliers all of which have designed or adapted software for the airline industry. But which systems are available, and what solutions are offered?

As a general rule, the most effective IT systems take a complex process and simplify it, since this is a basic requirement.

Aircraft Commerce will review systems and solution options in forthcoming issues, with this first focus examining what is required to introduce effective technology to an airline, or for an airline to upgrade its IT systems.

This review shall focus on the areas of commercial operation, which the major carriers mastered years ago but younger carriers are still exploring.

This review will examine computer reservation systems (CRSs), revenue management, inventory, pricing, network planning/forecasting, fleet assignment, scheduling, marketing information data (MIDT) and revenue accounting. The article is intended to step through the reservation and strategy process for an airline, indicating what systems are available to it for each step or process. This article will also provide an overview of the major vendors, and the products they have in each of the listed areas.

There are dedicated, boutique style, software developers in most categories and these shall be included when the relevant area is reviewed. For now the focus will be on the larger suppliers, and the options they provide.

The chart *(see table, page 21)* provides an overview of the services available.

CRS systems

These form the backbone of an airline, since the CRS controls the display and sale of inventory. Many airlines have their own in-house systems that have evolved over 20 years or more. Airlines are increasingly outsourcing the CRS role to third parties.

British Airways migrated from its own system (BABS) to Amadeus in February 2002, and Qantas will do the same in November. Amadeus also holds smaller airlines. Qatar Airways migrated in June 2001.

Many low-cost airlines employ an integrated system that combines CRS, revenue management, and revenue accounting into one package. The leader in this area is the Accenture product, 'Openskies', which has a virtual monopoly on low-cost carriers, such as BMI Baby, Virgin Express, easyJet, Ryanair, and Go in Europe; Virgin Blue in Australia; AirTran and JetBlue in the United States.

The Sabre CRS was designed by American Airlines, and has evolved over the past 20 years. Sabre is the dominant global distribution system (GDS) used in the US, and brings significant benefit to US airlines as a result. Duplicate bookings are reduced, as mirror passenger name records (PNRs), or booking references, are not required. A mirror PNR duplicates the passenger booking in a GDS with the airline's CRS. Often incompatibility issues occur and one party cannot see the changes made by the other.

As a relatively new entrant in CRS systems, Amadeus began operating in 1992. It has expanded aggressively, and gained many new customers, including British Airways and Qantas.

Mercator offers the MARS system, while SITA is another entrant in this market, with its GABRIEL system. This is integrated with SITA's popular DCS system.

Amadeus is developing a new generation inventory system that will be compatible with its CRS system, obviating the need for Amadeus users to employ a different inventory system as is currently required. Currently, the seats available (the inventory) are displayed in Amadeus. The actual seats available and the relevant reduction due to sales must be hosted in another system.

Openskies is unique because it performs the entire booking, revenue management and reconciliation process; an integration which is not offered by the other systems. The one-stop-shop system offers the best value for money. As an overall solution, it has a significantly cheaper segment booking cost. This is a main driver in its virtual monopoly with low cost carriers.

Inventory control

This is the link between revenue management and the CRS, which manages the seats available for sale. When a booking is made in a GDS or via the airline's CRS (for internet and phone sales), the available seats are reduced accordingly. The CRS may not necessarily host the inventory, as is the case with Amadeus where users rely on a different system. Qatar Airways, for example, uses LH Systems to hold its inventory, while British Airways uses its own system.

The link between the inventory, CRS and revenue management is critical. If it is not correct seat availability is incorrectly displayed, resulting in missed sales or overbooking. LH Systems and

Mercator provide inventory hosting. Mercator hosting is done in its MARS CRS system. Amadeus purchased the British Airways (BA) inventory system, RS13, as part of its partnership with BA and is also developing a new-generation inventory system, which will remove the need for third-party hosting.

Revenue management

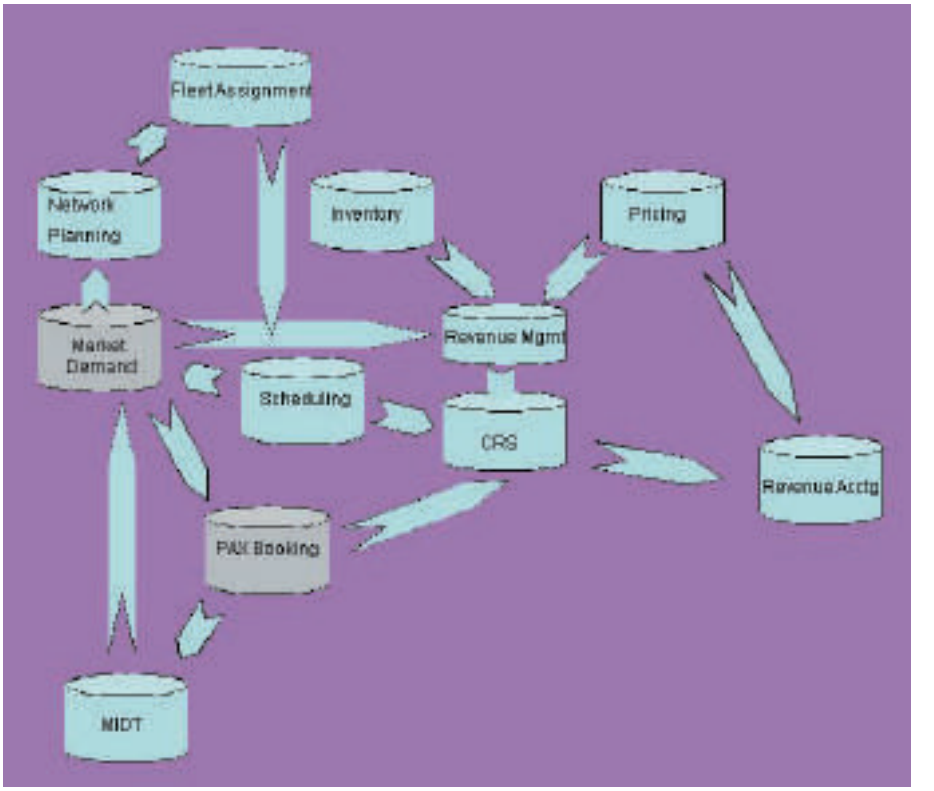
Revenue management systems vary in price and sophistication, and are a large expense for airlines. If selected and implemented correctly they are extremely effective. If done incorrectly they are an expensive mistake.

The revenue management option available to an airline is driven mainly by the airlines philosophy. Carriers like BA, Cathay Pacific or United, which rely on network feed, require a revenue management system that will optimise revenue based on origin and destination (O&D) demand, with an emphasis on the whole trip (itinerary), rather than each sector. Although a low-cost carrier which only has point-to-point traffic does not need sophisticated O&D control, it requires a sector-based system that optimises to get maximum revenue. Despite the complexity, all systems perform the same two roles: to optimise inventory based on residual demand, and to overbook the planes' physical capacity, to reduce the number of unsold seats.

To achieve this airlines and the software companies have many options. BA has its own in-house system called Cobra, for demand forecasting, and RS-13 for inventory control. It is not unusual to have two systems controlling revenue management. Northwest used PROS (for forecasting) and Worldspan (for inventory). Carriers like United and American have their own systems that are driven by powerful computers. Most airlines rely on major vendors for their systems.

Sabre offers Airmax, which is used by many airlines, and was one of the first revenue management systems. The current version offers O&D control, which has a sophisticated optimisation process that calculates and prices the revenue benefit of each O&D. Airmax and PROS seek to offer airlines solutions that optimises all the O&Ds that flow over their networks. O&D control is difficult to attain without married sector logic within the PNR. Married sector logic cancels all segments in a passenger's trip if it cancels one leg, so inventory is released. Very few airlines are able to approach this level, as it is technically difficult. PROS is popular among revenue management departments, and has won many recent contracts from Sabre, including Air New Zealand.

Openskies has revenue management built into its system. While not as technically advanced as Sabre or PROS in managing O&D flows, revenue management is not as sophisticated for its clients. Low-cost carriers seek local traffic, and do not want to bother with sector versus leg displacement theory; which optimises the flight over multiple legs. Displacement theory ensures that the passenger with the highest revenue contribution over its full itinerary will be accepted ahead of a passenger flying a single sector, even if it is paying more for the single leg. Low-cost carriers do not have advance purchase rules like hub carriers, having only one fare available at any given time; the lowest fare. Many hub-carriers can have up to 30 fares for sale at the same time. Low-fare carriers eschew complexity, and this especially applies to revenue management. They only require a system that can overbook with accuracy to avoid seat wastage, and a good forecasting system that will close the lower yield seats based on residual demand. Openskies is effective at this, and its popularity is proof of its effectiveness.



The IT systems are designed to assist in the capture of passengers. Passenger demand is used by network planning to determine the optimal schedule and fleet types; which then influence the scheduling system when a schedule is created. Passenger demand is fed into the revenue management system to determine the allocation of seats. Seat allocation is stored in the inventory system, and displayed in the computer reservation system (CRS), inventory is linked to the CRS system via revenue management.

The pricing system is controlled by revenue management, which also optimises the inventory allocation. Revenue management updates the CRS to ensure the optimal mix of fare-classes is displayed.

A passenger booking is received by the CRS, which removes a seat from the inventory system, and stores the information in the CRS. The passenger booking is the feed for the marketing information data (MIDT) system, which is a standalone function. MIDT is used to measure passenger demand.

The revenue management system will reforecast passenger demand to ensure the booking conforms to demand parameters. The passenger booking is held in the CRS until after passenger departure. It is then transferred to the revenue accounting system. The pricing system is linked to the revenue accounting System, which matches the CRS data to the pricing data. Any variation is identified.

Pricing

Pricing systems fulfil two general functions: to manage and track the various fares that an airline publishes;

Reservation systems are the backbone of any airline. All IT systems must be able to integrate into it. Integrating 1960s technology (CRS) with modern IT software is a huge challenge.

and to optimise pricing based on connection pricing and competitor response. A basic pricing system stores and categorises fare data, and is a feed to revenue accounting during the revenue integrity process. The pricing system stores the fare-rules, price, booking class and other essential information. The same data is sent to the airline tariff publishing company (ATPCO) to enable fares to be published. Network carriers have thousands of different fares that apply to their routes, with different pricing occurring if the journey goes over a congested hub, or via an alternative routing.

More complex systems allow the pricing department to have virtual booking hierarchies, where the reservation class is not the same as the booking class. That is, a reservation class is often different to a booking class to ensure the passenger is captured. If a passenger books a journey in Q class but not all segments are available in Q class to complete the itinerary the passenger may have one segment placed in a higher class like Y class to complete the fare. The systems also allow the pricing department to automatically interrogate the fares of competitors, and match or undercut the lowest fare they are offering. PROS and Sabre are leaders in this area, with their pricing optimisation systems (not surprisingly) an extension of the revenue management system. Each offers an automated pricing system that prices the same O&D differently depending on the connect points that can be used to complete the journey. For example a journey from LAX-JFK on United could be priced as a non-stop, a connection via Chicago, a connection via Denver, or a connection via Houston. The pricing would reflect the demand over both segments. The analysis, like the revenue management process, is driven by forecast seat revenue on each segment. As a network increases, the number of options is magnified, and pricing complexity becomes unmanageable.

Sabre, Mercator, LH Systems and PROS offer pricing optimisation and management systems, while providers including SITA offer an advanced fare optimisation system. The complexity of a network pricing structure requires a more sophisticated (and expensive) system such as that offered by PROS and Sabre.

Low-Cost carriers do not have this fare complexity, because their fares are combinable and they generally do not price itineraries. They only price individual segments that can be combined to create an itinerary. One exception is Virgin Blue in Australia, which prices itineraries, not just individual segments. It sells a PER-BNE fare that is less than the combined fare of the actual PER-SYD-BNE routeing.

Network planning/forecasting

There are many firms, mostly consulting companies, that offer network planning models. These models are designed to measure connections generated within a network, and assign a predicted volume of passengers based on a formula of the analysed carrier versus the competitors to reflect market share.

These models allow an airline to measure the network impact of changing, adding or deleting flights. A market size reflects the passengers moving between two points (true origin and true destination). An accurate market size is needed to ensure forecast validity, as without it the forecasting process cannot be reliably carried out.

Forecasting models generally use one of two methods: QSI or Logit.

QSI (Quality of Service Index) seeks to reflect consumer preference, and is a linear process. As flights, frequencies and aircraft sizes are altered, QSI increases or decreases in a linear fashion.

Logit (Logarithmic regression) plots a line of best fit based on a sigmoid curve, and calculates based on squared coefficients. Logit is more difficult to calibrate than QSI, but its complexity makes it more robust for highly sophisticated analysis. Sabre, Roland Berger Consulting, and LH Systems offer Logit models. Consulting companies APG, SH&E, and Khiel-Hendrikson offer QSI. LH Consulting offers both types.

Airlines are generally divided on the model types; Austrian, Lufthansa and Swiss use Logit, while Air New Zealand, British Midland and All Nippon use QSI. Major airlines United and US Airways use both types of systems. Each system has its benefits, but due to its simplicity QSI is generally more favoured. Logit calibration can take over eight months, while QSI calibration can be done in two or three days.

Fleet assignment

It is difficult to determine an airline's requirement for fleet assignment modelling (FAM). While airlines can get by without using this type of software, those airlines with complex fleets can gain value from its use.

MAJOR IT PROVIDERS OF DECISION SUPPORT SOFTWARE

SUPPLIER	CRS	MIDT	RM/ Inventory	Pricing	Network Forecasting	Fleet Assignment	Scheduling	Revenue Accounting
ABACUS	YES	YES						
AMADEUS	YES							
KALE CONSULTANTS				YES				YES
LH SYSTEMS		YES	YES		YES		YES	
MERCATOR	YES							YES
OPENSKIES	YES		YES	YES				YES
PROS			YES	YES				
SABRE	YES	YES	YES	YES	YES	YES	YES	YES
SHEPHERD SYSTEMS	YES	YES						
SITA	YES		YES	YES			YES	
SH&E			YES		YES			

FAM takes the operating constraints of an airline including maintenance, crew bases, and overnight rules and assigns aircraft to get the greatest financial return and highest possible aircraft utilisation rates. FAM can enable an airline to operate its current schedule using less aircraft. Generally a benefit accrues if the airline has six or more aircraft types in their fleet, irrespective of total fleet size.

The process takes all the possible scenarios, termed constraints, and passes them through a solver process to get the optimal result. However, multiple scenarios and multiple sensitivity models need to be performed to determine the best mix of aircraft. This analysis is especially valuable in re-fleeting, since multiple scenarios using myriad aircraft types can be used. The analysis will show the optimal fleet mix based on the cons

These systems are highly complex, with few firms offering a system that performs this task.

Scheduling

The scheduling and flight planning function is often overlooked, because airlines continue to plan their schedules in Excel or a similar package. The primary requirement of a scheduling system is to manage the inbound and outbound sectors, and produce the SSIM file that updates the CRS and other information groups. SITA, Sabre, and LH Systems all have systems that perform these types of functions. A scheduling tool is not generally required for fleets below 12-15 aircraft, as the benefits only accrue with fleet size closer to 20.

Most systems allocate flight-time, block-time, turn-time and other operational criteria enabling a working schedule to be created quickly. The systems also check for imbalance on the schedule, such as an outbound leg that does not have a return. Generally, the flight planning systems also produce slot requests. As a schedule is altered, the relevant slots need to be updated with the authorities. This process is time-consuming, and an automated process is preferable. Some systems separate the slot management system, and require it to be purchased as a separate module.

MIDT

Marketing Information Data (MIDT) records all the bookings made by a GDS on all airlines, providing vital marketing intelligence on the passenger levels carried by competitor airlines. MIDT is a major cost for airlines, which is the main reason why smaller airlines do not purchase it.

MIDT can be broken into three parts: data providers; data processors, and the decision systems.

The data providers are the GDSs. Of which the major ones are: Abacus, Amadeus, Sabre, Gallileo/Apollo, Worldspan, and Topaz. There are other regional providers, but their market penetration is questionable. A combination of the above GDSs will provide all the relevant data. Most of the GDSs provide subsets of their worldwide data to reduce the monthly cost. Depending on the needs of the airline, the subset can be altered for its market, reducing the cost, which is mostly calculated on a data volume output basis.

The data processors are those groups that take the raw MIDT and process it into a meaningful format. This includes trip-break rules, sale point identity and true origin and destination. Most GDSs offer this service, while other companies also provide this step. Amadeus uses its own in-house processing, as does Sabre.

Gallileo/Apollo uses Florida-based Shepherd Systems, which it purchased in 2001. Shepherd Systems is the sole vendor of Gallileo/Apollo data, and also offers the end user product as well. Lufthansa Systems offers a processing option, as does Kenji Systems. Other organisations are able to offer this service, and will be covered during the MIDT review in a later edition of this publication.

The decision system is the query tool that the user sees when placing an MIDT query. This is often web-based, as is the case with the Shepherd Systems suite, but can also be Network connected. Usually this involves the airline storing its MIDT in a data warehouse, and querying it with an appropriate tool. Air New Zealand follows this path and uses Oracle Discoverer. A Web-based decision system is more attractive because it can be accessed from any location. Lufthansa Systems offers MIDT processes, Sabre offers Litevision and Wisevision, Shepherd Systems offers Market Master. Amadeus does not offer an in-house product.

Revenue accounting

This is the final part of the revenue and yield management process, where tickets are processed and billing occurs. With the exception of TCN data, all airline revenue reports originate from revenue accounting data. TCN data is a revenue report captured at time of booking to estimate the passenger revenue prior to travel and coupon capture. The systems must be able to cope with retaining the flight data down to the coupon level, and also provide billing and auditing systems for the airline to process inward and outward billing, on both a sampled and non-sampled basis.

Sabre offers the Quasar system, which offers the standard functionality that all other systems provide, including reconciliation, fare auditing, and billing.

As with all Sabre products, it is vertically and horizontally integrated, so

Integrating passenger movements and modelling passenger demand can yield huge benefits for an airline, providing passenger demand can be accurately predicted.

the system compatibility is assured. LH Systems provide customised services that can comprise revenue accounting, which includes the use of SAP software.

Mercator offers a dedicated package, RAPID, which has proven popular with carriers due to its ease of use, and integration ability.

Another solution provider is Kale Consultants, based in India, and its PRAXIS system. Qatar Airways switched to Kale in 2001, having previously used the BA system. Kale provides the revenue accounting software/support for other airlines, including Air Luxor. Outsourcing this complete function is very popular, since it is a complex function that requires a high level of manual intervention. This explains the drive to locate the majority of the revenue accounting function in areas where labour is cheaper: Air New Zealand processes in Fiji, Qantas and British Airways in India.

Revenue accounting is a very complex process, requiring multiple auditing procedures to perform the IATA billing process for interline sales, and the required pro-ration factors. Pro-ration is the process where revenue for an itinerary is divided between the segments that make up the itinerary. This process can be a complex mathematical equation, especially if it involves different airlines.

Without this process the system loses complexity, and processing sophistication does not need to be as high. Openskies is used by airlines that do not require billing procedures, because they do not allow interline fares, nor do they require complex revenue pro-ration systems; pro-ration is usually based on the miles square-root calculation. Openskies is an inclusive system that functions for the major areas of the airline. It is an effective but straight-forward system that has gained huge popularity among the budget operators where the 'keep it simple stupid' philosophy is paramount.

The final area that adds complexity is the revenue integrity/auditing process. This matches the ticket to the booking to ensure no fare-rule violation has occurred. If a violation does occur an agency debit memo (ADM) is raised. The ADM is essentially a fine levied on the issuing agent (for example, a travel agent) for the fare rule being broken. This function does not apply to low-cost carriers. The sheer logistics of checking every ticket and PNR, however, is difficult. Airlines therefore often take a sample as an indication of the population, or do not perform this function at all, losing valuable revenue through ticket fraud.

In selecting a revenue accounting system, the airline must determine its needs, both present and future. It needs a system that can handle increased complexity, otherwise it risks losing revenue from incorrect billing, pro-ration, and fare abuse.

Summary

The options available for revenue and yield management and ticket distribution IT systems are numerous. It is easy for an airline to be distracted from its primary needs by pursuing systems that are not suitable to its requirements. Over the coming issues, *Aircraft Commerce* will analyse the performance of all the available systems in each category, and review their applicability. Each system has value, and it is very rare for a software package not to be useful. However, software requirements for a carrier with high fleet and O&D complexity differ from those for a carrier with no network requirements, or an emerging carrier with a simple route structure.

The decision support software available can take complex tasks and simplify then. However, there is also the danger that the systems can take simple tasks and complicate them. Without a sound knowledge of revenue management principles or a grasp of forecasting fundamentals it would be foolish to assume that the output from any system is perfect. There is still a requirement for airlines and analysts to understand the processes that these systems are seeking to perform. *Aircraft Commerce* will provide a breakdown of the performance and benefits of these system types, to allow the user to more closely identify the system that would best suit its needs. As an analogy, airlines generally do not buy aircraft that are too large or too small; they purchase the type that best suits their immediate and future needs. The same principle should apply to decision support systems. AC