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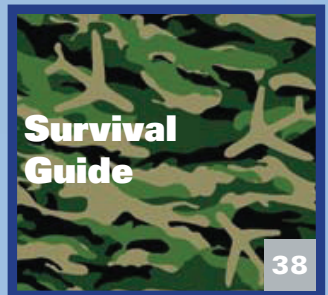
Taking your airline to new heights

A Clear Vision

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AIR NEW ZEALAND

FORWARD LEAP

AIR NEW ZEALAND EMBRACES INNOVATION IN BOTH ROUTING AND FLYING TECHNIQUES TO GENERATE SIGNIFICANT FUEL SAVINGS AND REDUCED CARBON DIOXIDE EMISSIONS ON A ROUTE FROM NEW ZEALAND TO THE UNITED STATES.

■ By Shawn Mechelke | *Ascend* Contributor



Photo courtesy of Boeing

profile



During its economically and environmentally significant flight last September, called ASPIRE 1, Air New Zealand saved approximately 1,174 U.S. gallons of fuel and reduced CO₂ emissions by some 11,218 kilograms.

Two basic necessities in the global air transport industry — saving fuel and reducing potentially environmentally harmful CO₂ emissions — are linked directly to greater efficiency.

And greater efficiency is precisely the goal that Air New Zealand has effectively targeted in its innovative application of advanced routing and flying procedures on its trans-Pacific route between New Zealand's global economic hub in Auckland and the California coast at Air New Zealand's North American destination in San Francisco.

Considering the entire process, Air New Zealand has helped enable the aviation industry to make a leap forward in defining both a more environmentally friendly and economic means of operating aircraft over long trans-oceanic distances.

On Sept. 12, Air New Zealand completed what is now recognized as an economically and environmentally significant flight of a Boeing 777-200ER aircraft from Auckland to San Francisco.

Before and during this historically noteworthy flight called ASPIRE 1, Air New Zealand applied broad capabilities in the areas of advanced flight planning techniques, datalink communications and air traffic control advancements to reap highly impressive results in trip fuel savings totaling approximately 1,174 U.S. gallons as well as approximately 11,218 kilograms in reduced CO₂ emissions.

Combined concerns revolving around global climate change, ongoing measurable

ozone depletion and the overuse of natural resources (as represented by petroleum products) have intensified the sense of urgency felt by Air New Zealand executives to position themselves on the leading edge in identifying new operational methods for the carrier's scheduled flights — especially flights across the vast distances of the Pacific Ocean.

In coordination with innovative oceanic air traffic procedures, Air New Zealand has implemented advanced flight planning techniques to set a new standard in trans-Pacific travel.

Air New Zealand determined that approximately 42 percent of the total fuel savings on the Auckland-San Francisco flight is attributable to calculations and decisions derived from data supplied by Air New Zealand's flight planning system, *Sabre® Dispatch Manager*.

The remainder of the credit for Air New Zealand's significant achievement goes primarily to the most advanced air-navigation services provided by several government agencies, including Airways New Zealand, Airservices Australia and the U.S. Federal Aviation Administration.

In incrementally analyzing Air New Zealand's remarkable accomplishment, it's important to examine the flight's sequential process — from preflight stage through take-off and climb, cruise, descent, and finally the flight's landing at San Francisco International Airport.

Air New Zealand uses *Dispatch Manager* to create optimized flight plans, which are then

sent via datalink communications to an Air New Zealand aircraft cockpit's flight management computer. This includes the flight plan itself, plus enroute wind and temperature data.

The carrier is able to analyze historical fuel-burn data for each of its individual aircraft (compared to what was flight planned) and adjust its fuel-burn calculations accordingly for each aircraft, including calculation of a performance-deterioration allowance.

To analyze this factor in proper context, the airline takes into account that as aircraft age, their fuel-burn performance is altered. Air New Zealand monitors the fuel-burn performance of each of its aircraft on a daily basis and makes weekly adjustments in its aircraft fuel-burn data. It also considers these measures a collective maintenance practice, which are followed to produce highly accurate flight plans based at least partly on the specific expected fuel-burn performance of each individual aircraft.

As another key factor that results in highly accurate flight plans, *Dispatch Manager* receives an updated set of worldwide wind and temperature forecasts every six hours. Air New Zealand flight dispatch officers are then able to use these latest wind and temperature forecasts in the preflight planning stage to create the initial flight plan for any given flight's departure.

Further augmenting the flight-plan accuracy (as based on the most recent six-hourly wind and temperature data), Air New Zealand maintains various items of direct-operating-

cost information in the flight planning system, including fuel costs.

To determine the optimum route and altitude for a particular flight, the Air New Zealand flight planning engine uses the latest wind and temperature information, plus highly reliable direct-operating-cost data. The carrier then calculates the cost of flight time cross-referenced against the cost of fuel and eventually arrives at a cost index that will result in the minimum total cost for the flight.

The cost-index data correspond to the performance data in the aircraft's flight management computer and provide guidance to the flight crew as to the performance profiles to use in the climb, cruise and descent flight phases.

As a result, variable cost-index calculations can be computed preflight as well as while the aircraft is en route — every six hours, when wind and temperature updates are received. The flight-plan route, winds, temperatures and cost-index setting are sent to the aircraft's flight management computer via datalink communications.

In addition to its *Dispatch Manager* flight-planning capability, Air New Zealand uses aircraft situation display technology via the *Sabre® Flight Explorer® System* to graphically view and track a flight's progress in real time while the aircraft is en route from takeoff to landing.

The aircraft situation display, in addition to the flight-planning system, can also be used to guide Air New Zealand flight dispatchers in determining optimum routes by using the system's weather-overlay capabilities plus satellite imagery to compare and take into consideration graphical forecast weather conditions along the route, including potential turbulence and icing as well as areas of thunderstorm activity in relation to the planned route.

In addition to the optimization provided by the flight planning system, an Air New Zealand flight dispatcher can assess the overall route and determine if it needs to be adjusted at certain points due to locally adverse weather conditions.

All of the factors are in place, then, to allow flight planners to take into consideration not only a vast array of weather variations that can affect a flight, but to allow the planners to construct a route with both fuel savings and minimal CO₂ emissions in mind. And in the preflight stage, Air New Zealand uses *Dispatch Manager* to determine the most economical flight route — looking to identify a route requiring the least amount of fuel and generating the lowest CO₂ emissions.

As a key element in this process, Air New Zealand defines for the flight a user-preferred route, or UPR. UPRs have been operational in the South Pacific oceanic airspace for a number of years, enabling carriers to plan optimized routes based on better flight

efficiency in taking advantage of the benefits of prevailing wind patterns rather than simply being required to fly fixed city/pair routes.

Fixed routes — whether in the form of permanently defined tracks or flex-tracks (flex-tracks, effectively, are fixed tracks defined daily) — are not essential in the Auckland oceanic flight information region (managed by the government agency Airways New Zealand using its oceanic control system, or OCS) and the Oakland flight information region (managed by the FAA using its Ocean21 system).

HIGHlight

In coordination with innovative oceanic air traffic procedures, Air New Zealand has implemented advanced flight planning techniques to set a new standard in trans-Pacific travel.

In the pre-departure phase for Air New Zealand's flight from Auckland to San Francisco — using the calculated cost index and the latest enroute upper-air wind and temperature forecast — the carrier used *Dispatch Manager* to calculate the track between Auckland and San Francisco that would most effectively minimize fuel usage and emissions.

This route is the UPR, implementation of which requires air traffic control systems that are able to support aircraft operating outside of predefined airways. With Air New Zealand's OCS and the FAA's Ocean21 — as well as their real-time conflict-probe capabilities, which instantly probe for conflicting factors with regard to any revision of flight profile — there is no requirement for traffic to maintain fixed routes in order for air traffic controllers to be able to identify conflicts.

Once calculated, the user-preferred route is digitally uplinked to the aircraft, inclusive of the wind and temperature data for loading into the aircraft flight management computer. The fuel saved on this flight through the implementation of UPR amounted to approximately 420 U.S. gallons and UPR was also accountable for approximately 4,015 kilograms of reduced CO₂

emissions (emission reductions and fuel savings across the entire flight).

Other factors in the initial stages of the flight also figured into the greater fuel equation. In an aircraft's climb after takeoff, for example, there are numerous disparate factors that must be balanced to arrive at an optimum operating procedure.

When considering climb power, the use of a derate climb power, or a power setting that is up to 20 percent below the aircraft's maximum climb power, serves to significantly improve engine life potential and thereby lower maintenance costs, but the use of derate climb power also effectively increases the overall amount of fuel consumed during this flight phase.

Even under the effects of fairly recent higher fuel prices, however, the savings to a carrier in terms of engine maintenance costs would still exceed by more than double the cost of fuel that could be saved in this flight phase. Thereby, derate climb power has remained Air New Zealand's preferred option.

Climb speeds on Air New Zealand aircraft, incidentally, are set automatically through the mechanism of a cost-index factor that is entered into the aircraft's flight management computer.

And some of the things that figured in later during the Auckland-San Francisco flight took on even greater significance. Once at cruising altitude, for instance, the flight gained an advantage through the six-hourly update of the upper air wind and temperature forecasts received through the flight planning system. A process called dynamic airborne reroute procedure, or DARP, is applied in effectively re-planning the flight en route.

On the Air New Zealand flight from Auckland to San Francisco, the DARP process was completed twice, thereby saving approximately 70 U.S. gallons of fuel.

Air New Zealand's use of DARP commences with an aircraft-datalink request for a DARP to the Air New Zealand flight dispatch office in Auckland. Immediately, the latest wind and temperature forecast becomes available, and the Air New Zealand flight dispatcher uses *Dispatch Manager* to recalculate the optimum track from a predetermined point just ahead of the current aircraft airborne position.

Once calculated, the revised route is uplinked to the aircraft for flight crew consideration. The crew then downlinks a request for the revised route to New Zealand's oceanic control center and, once approved, accepts the revised route into the active side of the flight management computer.

Another advanced air traffic procedure that now benefits Air New Zealand operations in the Pacific oceanic region is 30/30 separation.

Beginning in 2005, the Airways New Zealand and Airservices Australia agencies reduced the required separation between aircraft in their oceanic airspace to 30 nautical miles longitude and 30 nautical miles latitude — the first such reduced separation in international airspace



to be implemented globally. Within a year, the FAA followed suit with regard to its Pacific airspace.

Air New Zealand has invested in aircraft systems that enable the carrier to obtain approval for both RNP10 (which results in 50-nautical-mile lateral and longitudinal separation) and RNP4 (which allows the use of a 30-nautical-mile standard in oceanic regions).

This separation standard is now routinely applied on flights between Auckland and San Francisco, and 30/30 separation effectively pro-

vides the Airways New Zealand agency significantly increased airspace capacity as well as increased route flexibility, thereby enabling an overall reduction in fuel burn and CO₂ emissions from each and every aircraft operating in the region.

Air traffic control's ability to allow closer separation between aircraft therefore also reduces the number of times during which aircraft are held below the optimum altitude, and on this Air New Zealand flight resulted in savings of approximately

135 U.S. gallons of fuel and 1,290 kilograms in reduced CO₂ emissions.

The crew of the Air New Zealand flight was also able to make use of new descent and arrival procedures into San Francisco International Airport that saved approximately 200 U.S. gallons of fuel and 1,912 kilograms in reduced CO₂ emissions.

Through what is known as a tailored arrival, the descent and approach into San Francisco was optimized for efficiency.

Tailored arrival into San Francisco is a sophisticated application of a type of emissions-optimized arrival known as a continuous descent arrival. CDA allows an aircraft to fly a continuous-descent path to land at an airport, instead of the traditional step-downs or intermediate-level flight operations.

Using CDA, the pilot initiates descent from a high altitude in a near-idle (or low-power) engine condition until reaching a stabilization point prior to touchdown on the runway. CDA results not only in fuel savings and decreased emissions, but also significantly reduces noise beyond the airport.

The tailored arrival then takes the principles of the CDA a step further by identifying the most beneficial flight path available by integrating all known aircraft performance, air traffic, airspace, meteorological, obstacle-clearance and environmental constraints expected to be encountered during the arrival phase.

So in a broad analysis, the combination of Air New Zealand's desire to pursue a "green" approach in the air — combined with state-of-the-art technologies as well as innovative air traffic control systems from government agencies, Airways New Zealand, Airservices Australia and the FAA — made this particular Air New Zealand flight something of a high-profile case study, worthy of both detailed analysis and emulation.

And the entire aviation industry appears to have taken notice. In a remarkable globally significant accomplishment, Air New Zealand has effectively demonstrated how to operate aircraft over long oceanic distances while creating a considerably smaller environmental footprint and saving substantial amounts of fuel.

Today, there are more than 150 flights per week connecting New Zealand and Australia to the United States and Canada. Based on these flights alone, the potential total annual savings are in excess of 10 million U.S. gallons of fuel and reduced CO₂ emissions of more than 100,000 tons ... simply by following the principles that have been established and proven effective by Air New Zealand during a memorable flight from Auckland to San Francisco. [F](#)

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Fuel Savings Across Air New Zealand ASPIRE 1 Flight

	U.S. Gallons	Liters	Reduced CO ₂ Emissions (Kgs)	Percentage Of Total
Pre-Flight, Taxi And Takeoff				
Fuel saved by reduced auxiliary power unit use	60	227	574	5%
Fuel saved by "just-in-time" refueling	68	257	650	6%
Fuel saved per minute that taxi time is reduced	1	4	10	0%
Departure And Climb				
Fuel saved by use of maximum climb power setting	40	151	382	3%
Enroute Cruise				
Fuel saved by use of user preferred route (average)	420	1,590	4,015	36%
Fuel saved by dynamic airborne reroute procedure (average)	70	265	670	6%
Fuel saved by slower cost index	90	341	860	8%
Fuel saved by optimum altitude	135	511	1,290	11%
Totals	715	2,707	6,835	61%
Descent And Approach				
Fuel saved by use of tailored arrival	200	757	1,912	17%
Fuel saved by "delayed flap extension"	80	303	760	7%
Taxi And Arrival				
Fuel saved by reduced APU use	10	38	95	1%
Total Savings	1,174	4,444	11,218	100%

According to Air New Zealand, approximately 61 percent of the total fuel savings on its ASPIRE 1 flight last September were attributed to the carrier's state-of-the-art flight planning system, *Dispatch Manager*, part of Sabre® AirCentre™ Enterprise Operations.