MANAGING CONTINGENCY FUEL

UPLIFT WITH ADVANCED ANALYTICS

Honeywell

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RISING PRICES DRIVE FUEL-EFFICIENCY INNOVATIONS

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Rising jet fuel prices are putting enormous bottom-line pressure on the world's airlines. Airline executives watched fuel prices soar 54 percent in just a year (June 2017-June 2018), according to the International Air Transport Association (IATA). Increases in the first six months of 2018 added more than $42 billion to carriers' operating costs, IATA estimates.

No wonder airlines are stepping up their fuel-efficiency efforts. Airlines cannot impact the effect of macroeconomic factors on global oil prices. What they can do is enlist the help of everyone from the flight line and the operations center to the flight deck and the boardroom to find ways to reduce fuel consumption without affecting on-time performance.

Reducing aircraft weight is a tried-and-true way to improve fuel efficiency. The severity of the recent fuel-price escalation has caused airlines to seek ways to slim down their aircraft and manage payloads. They are examining everything from onboard equipment, aircraft livery and seats to cabin service items and catering to try to reduce the weight of just about everything on the airplane.

The reason is clear. Depending on the airplane type and configuration, it takes 3-4 kilograms of fuel per hour to carry each 100-kilogram load. Excess weight causes billions of dollars in lost profitability across the airline industry each year.

Ironically, fuel itself is a large component of the weight carried on a typical flight. Major fuel-economy benefits can be realized if airlines load the optimum amount of fuel for each flight. That is where advanced analytics come into play. Innovative software solutions can be used to inform the refueling process and enable airlines to specify the right fuel load for each unique flight.

ECONOMICS OF CARRYING CONTINGENCY FUEL

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Deciding how much fuel to load onto a commercial airplane before it takes off is a complex process. It is governed by multiple factors, including the aircraft type, time of the year, planned zero-fuel weight (ZFW) and equipage. Also considered are the actual weight of the cargo and passengers on board; the distance to be flown on a particular route; anticipated time spent flying, taxiing and holding and the physical conditions the flight is expected to encounter, like air temperature, wind speed and weather.

In addition to the fuel required to reach the destination airport – the mission fuel – airlines are required by governing bodies including the U.S. Federal Aviation Administration (FAA), European Aviation Safety Agency (EASA), the International Civil Aviation Organization (ICAO) and others to carry contingency fuel.

For example, the FAA requires enough reserve fuel to hold at normal cruising speed for 45 minutes or to reach an alternative landing site if indicated by weather conditions at the destination airport. Other governing bodies use comparable guidelines governing the amount of reserve fuel an aircraft needs to carry.

Contingency fuel is loaded to address unforeseen circumstances and enable airlines to avoid the severe financial and operational implications of needing to divert to another airport due to a minimum or emergency fuel situation. Based on their previous experience along a given route, pilots and flight dispatchers may choose to load discretionary fuel amounts beyond the mandated contingency levels.

Historically, airlines are very conservative in their fuel-loading practices, which means they usually add more fuel – often substantially more – than is necessary to safely complete the aircraft's journey from the departure airport to destination. The cost implications of loading excessive fuel is enormous, particularly as jet-fuel prices continue to escalate.

In 2015, environmental researchers reported the results of a study conducted with one major U.S. airline. They found 4.48 percent of the fuel consumed on an average flight was due to carrying unused fuel, with 1.04 percent consumed to carry fuel "above a reasonable buffer."

NEW CAPABILITIES ENABLE PRECISE FUEL LOADING

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Standard reserve-fuel loading practices are rigid and do not take the unique nature of each flight into account. Instead, they direct airlines to use a standard percentage of the required fuel to determine how much reserve fuel to load. Civil aviation authority mandates vary, but currently the FAA requires reserve fuel to equal 10 percent of the mission fuel and ICAO requires 5 percent.

These agencies now are reexamining those mandates as the aviation industry pursues ambitious goals to improve fuel efficiency by an average of 1.5 percent per year through 2020. The industry is also looking to stabilize carbon emissions from 2020 on with carbon-neutral growth and achieve a net reduction in carbon emissions of 50 percent by 2050, compared to 2005.

At the same time, new products, services and software solutions have emerged that use advanced data analytics to provide airlines with precise, custom data that can accurately determine the optimum amount of fuel to upload for each flight. Civil aviation authorities recognize the potential of data analytics to improve fuel-load management by helping airlines do a better job of predicting the optimum amount of fuel to uplift. Aircraft manufacturers have also come to recognize effective flight plans in the past decade.

These advancements enable the use of Statistical Contingency Fuel, or SCF, which is a procedure to determine the required amount of contingency fuel as a percentage of planned mission (trip) fuel.

Unlike the fixed percentage-based process, SCF is highly flexible and uses an airline's own data to determine the correct percentage of contingency fuel to load. The SCF percentage varies depending on aircraft type and the departure and arrival airport. ICAO Flight Planning and Fuel Management Manual (2012, Appendix 4 to Chapter 5) has specific recommendations, examples and guidance material on establishing the criteria regarding the fixed and variable (statistical) percentages of contingency fuel. The FAA offers similar guidance through their Performance Based Contingency Fuel (PBCF) program, which is outlined in Ops Spec guidance to B343. Nowadays, worldwide civil aviation authorities are working with airlines to determine suitability of operating and analytical processes to enable the implementation of statistical contingency fuel (SCF). These include, but are not limited to: establishing a fuel consumption monitoring program viable to data audit; flexibility on used data e.g., seasonality; data quality and outlier flights detection mechanisms; integrated feedback loop with flight planning and dispatch. Where the processes and IT infrastructure meet their requirements, and conditions permit, authorities are willing to approve the use of SCF to calculate fuel loading on an airline-by-airline basis.

HONEYWELL FORGE FLIGHT EFFICIENCY

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Engineers at Honeywell Aerospace have developed software that provides airlines with the most precise fuel-loading guidance ever available. Honeywell Forge Flight Efficiency is an integrated service that uses advanced data analytics to give airlines the information they need to accurately estimate the amount of reserve fuel required for any given flight, based entirely on their own experience.

The company estimates that reserve fuel quantities can be reduced from today's customary 5-10 percent to the SCF quantity in the range of 3 percent or even less, saving hundreds of kilos of weight and dramatically reducing fuel consumption on a typical flight.

The capabilities of Honeywell Forge Flight Efficiency extend well beyond the software's ability to provide airlines with fuel-loading guidance. It helps airlines and flight crews make informed decisions before and during flight, balancing the need for fuel savings and on-time performance. It also provides data analytics tools that airline operations departments can use to view fuel-savings information and identify best practices enterprise-wide.

Developed using extensive airline and pilot input, Honeywell Forge Flight Efficiency consolidates flight plans, weather forecasts, navigation changes, aircraft performance data and other variables in one place. The service enables breakthrough fuel-saving strategies that have not been possible in the past, including easy-to-interpret data displays that let flight crews compare options and clearly see the impact of their decisions on fuel consumption. It uses airline-specific data to improve the accuracy of SCF calculations. Data from airline systems is extracted, cleansed and analyzed to provide the best-available information to airline decision-makers.

The Honeywell analytics platform analyzes route-specific and directional data for the quantity of fuel used while flying each way between city pairs. By examining the variation between the planned and actual fuel used over hundreds of flights and a two-year period, Honeywell is able to develop a highly accurate estimate of typical fuel usage. The SCF percentage is determined based on the empirical distribution of the deviation of actual trip fuel from the planned trip fuel.

The solution recognizes variation in fuel usage based on the direction flown. For example, there may be a smaller deviation on an outbound flight between Chicago and Phoenix than on the return flight. Considering this, it would be ineffective for the airline to load 3 percent of trip fuel for each leg of the flight. A better solution would be to attribute variations to the respective legs and load 1 percent on the outbound flight and 5 percent on the inbound.

In addition, contingency fuel requirements can vary based on the distance of a given flight. The accompanying chart shows the difference, or delta, for a medium-sized airline with a mixed fleet of aircraft. The most frequent deviations for shortest and longest flights are

in the 3-3.3 percent range, while flights in the midrange have a greater deviation mode (4.5 percent) and shorter flights have a smaller deviation. Longer flights have a wider (5.5 percent) deviation. The variation is often greater when a particular city pair is considered.

The Honeywell algorithm is a blend of engineering and flight operations knowledge combined with advanced statistical and machine-learning methods. Several components are considered including the amount of fuel typically used on a particular route with corrections and normalizations. These include the cost-of-carry weight for extra fuel and aircraft's actual and planned weight without fuel, ground distance between the city pairs, and the chosen coverage of 90, 95 or 99 percent.

Chosen coverage represents the empirical distribution quantile, which measures the percentage of flights that would have a larger fuel deviation than the chosen contingency fuel, measured in fractions of a percent. For instance, if the estimated contingency fuel percent with 99 percent coverage is 4.5 percent of mission fuel, this means that 99 percent of the flights will have mission fuel deviation less than 4.5 percent.

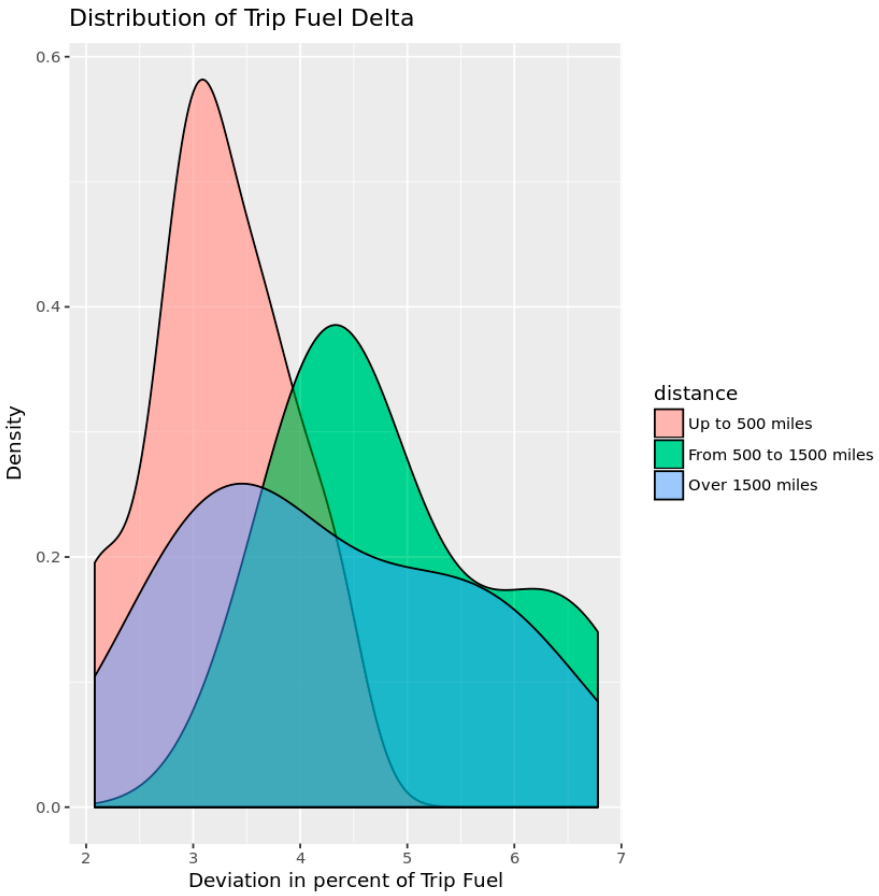

Figure 1: Empirical distribution of the trip fuel delta versus stage distance of an airline with mixed fleet.

Data also is normalized to reflect seasonal variations, like changing weather patterns that can cause delays or diversions. Honeywell continuously monitors each operator's experience to ensure that the custom algorithm for that airline is current and accurately reflects the fuel-loading recommendation for each city pair flown.

Honeywell Forge Flight Efficiency is easily integrated with major airline flight-planning systems such as LIDO and Sabre DM/FPM, so that fuel-loading recommendations are included whenever a flight plan is developed, saving time and hassle for the flight crew and dispatcher. Operators can also view an online dashboard showing as many as six methods for calculating SCF. Finally, Honeywell is very experienced with linking data from main airline systems such as Flight Operations and Flight Data Recorders.

CHANGING THE GAME ON CONTINGENCY FUEL MANAGEMENT

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As fuel prices continue to rise, airlines need to reduce fuel consumption and improve operational and bottom-line performance without negative effects on the passenger experience. They recognize the potential to leverage technology to better understand how they are using fuel today and how they can save fuel tomorrow. Contingency fuel management is a largely untapped opportunity to save fuel, reduce greenhouse gas emissions and add millions of dollars to the airlines' bottom lines.

Visit us online to learn how Honeywell is helping dozens of airlines with Honeywell Forge for Airlines, aviation's most intelligent data-driven platform.

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N61-126-000-001 I 08/19

THE FUTURE IS WHAT WE MAKE IT

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