O'HARE CROSSWIND/DIAGONAL RUNWAY LAYOUT AND USAGE

JDA Aviation Technology Solutions
4720 Montgomery Lane Suite 950
Bethesda, MD 20814
301-941-1460
info@jdasolutions.aero

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Contents

4720 Montgomery Lane Suite 950 Bethesda, MD 20814

www.jdasolutions.aero 301-941-1460

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1. Background

Chicago designed its airport layout plan for the O'Hare Modernization Program (OMP) to ultimately include eight runways and three major new terminals (Terminals 4, 6, and 7)[1]. The OMP Master Plan called for the construction of four new runways[2], the extension of two existing runways[3] and the retention of two existing runways[4]. (See Exhibit 2 attached hereto).

In addition, as part of its OMP Master Plan, Chicago calls for the closure of existing Runways 14L/32R and 14R/32L. (See Exhibit 1 attached hereto).

This paper examines the question of whether Runways 14L/32R and 14R/32L should be closed.

While significant portions of the runway construction proposed in the OMP Master Plan have been built[5], serious questions have been raised as to whether the remaining proposed runway construction (the proposed construction of 9C/27C and the extension of 9R/27L) – as well as the construction of terminals 4, 6 and 7 – should proceed. FAA's current forecasts of long-term demand (years 2015-2040) are far lower than the forecasts that were used as the justification for the scope of the runway and terminal components of the OMP Master Plan.

Further, no progress has been made on the proposed construction of more than two million square feet of new terminal capacity (including Terminals 4, 6, and 7) that was a key component of the OMP Master Plan, tied to the justification for the new runway system. The central logic of the extensive OMP's proposed runway construction was to balance the added runway capacity with comparable terminal and gate capacity. If traffic growth on which the OMP is based is allowed to grow with the addition of even more runway capacity – without construction of terminal and gate capacity -- congestion and delay will simply be transferred from the runway system to the airport taxiways, ramps, terminals and gates.

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1. A graphic depiction of Chicago's Master Plan for the OMP – also known by the FAA and Chicago in FAA's EIS analysis as "Alternative C" -- shows the ultimate proposed build-out of the new runways and the new terminals and is shown in Exhibit 2 attached hereto.
2. The new runways are 10R/28L, 10C/28C, 9C/27C, and 9L/27R.
3. The extensions of existing runways are at 9L/27R and at the runway originally designated as 9R/27L (now re-designated as 10L/28R).
4. Runways 4L/22R and 4R/22L.
5. New Runways 9L/27R and 10C/28C have been completed. Runway 10L/28R (formerly 9R/27L) has been extended; and Runway10R/28L is under construction and will be completed in 2015.

Fortunately, the current FAA long-term forecast demand (2015-2040) is so far below the forecast demand on which the OMP runway and terminal design is based that the Runway system in place at the end of 2015 should be more than adequate to accommodate the FAA forecast demand. In a companion analysis[6], the JDA aviation team (Trani, Voss, Burzych and Del Balzo contributing) conclude that the year-end 2015 runway system – with the exceptions discussed below – is more than adequate to accommodate forecast demand for decades to come (until the mid 2030s). Indeed, the JDA team's analysis of data on current delays experienced at O'Hare concludes that a principal cause of current delays is the lack of gate capacity – not lack of runway capacity. In the near term, O'Hare's delays would be better addressed with a modest increase in gates than by adding more new runway capacity.

However, the proposed closings of Runways 14L/32R and 14R/32L raise separate but related concerns about capacity, safety and environmental impacts of the OMP runway design. This paper questions the wisdom of closing the 14/32 runways – either under the prospective year-end 2015 runway configuration or the full-build "end state" runway configuration. Specifically, the removal of the northwest/southeast diagonal runways (14L/32R, 14R/32L):

- Could negatively affect the safety of flight operations under adverse crosswind, tailwind and contaminated runway conditions;

- Would increase the potential for increased delays, arrival go-arounds, in-flight diversions to other airports and cancellations during a small but significant number of days where weather conditions make crosswind operations imprudent or undesirable. There will be significantly less flexibility to provide runways aligned with high wind, and

- Would prevent the distribution of operations to provide periodic noise relief to those communities now facing concentrated noise exposure under the operation of the east-west runways. From an environmental perspective, additional noise impacts will be shifted away from areas to the northwest and southeast of ORD and more heavily concentrated into areas directly to the west and east of ORD-areas already impacted with additional aircraft over flights, noise and emissions following the last two runway openings (10C/28C and 9L/27L).

The goal of the ORD OMP plan was to improve efficiency, namely runway capacity, throughput and delay reduction. Mayor Daley announced the OMP Master Plan, as depicted in Exhibit 2, in June 2001 and the runway layout continues to be developed as he first described. Some feel that if the local air traffic staff and other user groups had been afforded greater initial input, a more efficient design might have resulted. Dallas Ft. Worth Airport (DFW) has been cited as proof of concept for the OMP layout. DFW utilizes five parallel runways and two diagonal runways, with high operational efficiency. However, wind and other critical meteorological conditions are unique from airport to

6. *An Analysis of the Need and Justification for the Additional Runway (9C/27C) and the Runway Extension of 9R/27L at O'Hare*]

airport, as is the air traffic. O'Hare's air traffic volume is 25% greater than at DFW7. With its northern climate, close proximity to Lake Michigan and location within the jet stream, ORD is unusually susceptible to rapidly changing weather, strong, sustained crosswinds, frequent wind gusts, rain showers, snow events, icing conditions, thunderstorms and contaminated runways.

2. Changes Pending and Problems with Next New Runway

The closure of Runway 14L/32R is scheduled to begin in August 2015. Navigation equipment from Runway 14L/32R (i.e., ILS) is scheduled for relocation to the newly built Runway 10R/28L. The October 2015 Runway 10R/28L commissioning will likely preclude any serious reconsideration of the Runway 14L/32R closure.

There has been some uncertainty expressed within air traffic how they will actually use the new Runway 10R/28L in October 2015, that essentially replaces Runway 14L/32R. Its short length, remote distance from the terminals and close proximity to Runway 10C/28C will somewhat limit its practicality. An offset arrival approach is being evaluated for Runway 10R during east flow, which could accommodate additional arrivals over the Bensenville area. This may reduce or eliminate the need for departing traffic to share Runway 9R with arrivals, improving the surface issue that requires extra arrival spacing[8]. However, the practicality of using an offset approach, if needed, while conducting triple simultaneous approaches could be limited in poor weather. Also, some operations on Runway 10R/28L may intensify airspace conflicts with traffic operating at nearby Midway Airport.

Starting in October, Runway 28L will be assigned to some westbound departures in west flow operations, requiring those flights to make an unusually lengthy taxi, often stopping to cross two longer active runways on the way. Many pilots will likely decline its use, knowing instead they will be issued a shorter taxi and takeoff from a longer runway (22L or 28R). The line of sight problem with Runway 10R/28L will require a dedicated (third) air traffic control tower to operate it, increasing controller and supervisory staff by adding approximately fifteen new air traffic controllers. This has already added $30 Million to taxpayer facility costs for the new tower, with additional federal payroll and benefits costs of approximately $3 Million annually, and in practice, will only be useable for at most a few hundred aircraft for a maximum of 16 hours each day.

3. Impact of Winds and Weather on Runway Layout and Selection

Surface winds are a key issue in airport flight operations. As wind velocity increases, aircraft must operate into the wind. Light winds (i.e., less than 5 knots or 5.7539mph) are usually insignificant and provide maximum flexibility; higher velocity crosswinds or

7. Total airport operations, 2012 through 2014. Source: FAA Aviation System Performance Metrics.
8. During east flow, there are difficulties crossing aircraft near the approach end of Runway 9R, especially arrivals from Runway 9L, as they conduct the lengthy taxi inbound from the north runway to the terminals.

tailwinds are significant and can constrain operations. Defining the optimal airport design, dynamic runway configuration and actual pilot or aircraft limits is complex. Flight safety is often stated as aviation's primary priority, but in reality some risk is absorbed in the interest of practicality, control of costs and operational efficiency.

There are several key policies and factors guiding the actual limits of adverse crosswinds or tailwinds that combine to determine whether an acceptable level of safety is achieved. Winds are rarely a direct headwind (blowing from the runway heading) or a direct crosswind (blowing perpendicular to, or 90 degrees from runway heading). Decreasing the angular distance between a direct crosswind and runway heading reduces the effective crosswind, or if behind the aircraft and its direction of flight, increases the effective tailwind[9].

Aircraft manufacturers do not prescribe maximum crosswind limits for the aircraft they build. Instead, they conduct certification testing on new aircraft models and publish the maximum crosswind in which test pilots have demonstrated a successful landing. In ideal conditions, most transport category aircraft can "demonstrate" or tolerate crosswinds from 27 to 40 knots, and tailwinds of as much as 15 knots. (1 knot = 1.15078 miles per hour, or 30 knots = 34.5 mph). It is important to note that intermittent wind gusts are often higher than the reported airport (centerfield) wind value and must be used by air carriers to determine aircraft performance limits dictated to their pilots.

O'Hare Airport wind analysis has been conducted by Dr. Toni Trani on the JDA Aviation Technology Solutions team, in accordance with FAA Advisory Circular AC-150/5300-13A. Dr. Trani studied 14 years of data and evaluated whether FAA design criteria would be met with the removal of Runways 14/32. The airport runway design criteria for ORD (D-VI) shows that without Runways 14/32, historic wind rose crosswinds (for single directional runways) of less than 20 knots at ORD occur at least 95% of time, which appears to satisfy the minimum criteria specified in the Advisory Circular guidance. Dr. Trani found that crosswind coverage, with existing runways, including Runways 14/32, meets the design criteria 100% of the time. Without Runways 14/32, crosswind coverage drops to 99.92%.

While lack of crosswind coverage .08% of the time (7 hours annually) might seem insignificant, this does not include wind gusts or other conditions, which sometimes renders certain runways unusable. There are a multitude of factors, including aircraft weight, loading (center of gravity), runway slope and grooving, equipment outages, wet runways, standing water or accumulated snow, low visibility, pilot restrictions (i.e., new to the aircraft) and other carrier specific regulations. While building a runway layout incapable of accommodating crosswind landings may be acceptable at smaller airports, one must question the wisdom of assuming such risk at the world's busiest airfield. For example, if using Runway 28C (heading 273) at ORD, with wind from 320 degrees at 30 knots, the crosswind component is reduced to 19 knots. While 19 knots appears within tolerance according to the FAA's minimum standards, the maximum crosswind

9. Though light tailwinds are not necessarily dangerous, aircraft performance decreases and operational risk increases, especially when other conditions exist such as a short or contaminated runway.

component for many airliners decreases to just 15 knots (or a 10 knot tailwind) when combined with low visibility (i.e., ¾ mile) or with wet runways. If Runways 14/32 are closed, during certain circumstances, it will be insufficient to have relied upon the FAA's minimum design criteria and unreasonable to consider O'Hare an "all weather airport."

FAA's National Safety and Operational Criteria For Runway Selection and Noise Abatement Runway Use Programs (Order 8400.9, pending in draft for implementation later this year) will soon limit Control Towers runway selection (assigning runway use) with crosswinds greater than 25 knots, including gusts- and just 15 knots if the runway is wet, in some locations even less. However, until then, it does not appear that historical wind analysis or tower runway selection included gusts. If so, this is a serious omission. Worse, there is sometimes a tendency for Control towers to issue inexact winds or continue utilizing the highest capacity runway configuration in borderline wind situations, until multiple pilots begin refusing to use the misaligned runways.

Pilots are the final authority to determine whether the winds are within their own limits and can refuse runway assignments that appear within the FAA's design, ATC or individual airline limiting criteria. Air Traffic Controllers suddenly trying to accommodate airborne pilot refusals with an approach to another runway can be difficult, especially if the only alternative is to land in opposite direction to the flow of other traffic. All involved know that refusals can force an untimely runway configuration change, causing the air traffic situation both in the air and on the surface to become complex, even hazardous. Unfortunately, this can cause pilots to be hesitant refusing a runway they'd prefer not to use, instead landing on a runway misaligned with strong prevailing wind conditions. Runway excursions (accidents) have sometimes resulted.

At Chicago Midway Airport, an aircraft accident occurred on December 8, 2005 involving a Boeing 737 landing on a runway not aligned into the wind. The winds were found as a contributing cause of that crash, in which there was one fatality. There was low visibility with snow, a contaminated runway and a tailwind component of 9 knots. The aircraft overran the runway and crashed through the airport perimeter fence and onto a public roadway adjacent to the airport.

A recent example of questionable runway usage occurred at O'Hare on May 17th, 2015. Runway 14R/32L was temporarily closed. In the late morning (i.e., 1130am), winds were strong from the southeast, reported as 160 degrees at 19 knots, gusting to 26 knots. The runway configuration was west flow, landing Runways 27R/L and 28C, departing Runways 22L and 28R (intersection departures). If Runway 14R/32L were available, the use of Runways 14R/14L would have been preferable from a flight safety standpoint[10]. Instead, aircraft were continually assigned runways with a 9 knot tailwind and at peak, a crosswind/quartering tailwind in excess of 30 knots. Even the use of an east flow

10. ATC is often hesitant to use a runway configuration most aligned with the wind, as a reduction in airport throughput (capacity) occurs when using fewer runways, such as when landing and departing Runways 14R/L. Switching from west to east flow drops arrival capacity by approximately 14 aircraft an hour in good weather and by 32 aircraft an hour in instrument (weather) conditions.

configuration would have upgraded operational safety. Fortunately, no mishaps were reported.

It is difficult to forecast the precise frequency in which ORD's planned runway layout will be inadequate. While there is extensive historic weather data available, there are limitations to its usefulness. The duration of precipitation, contaminated runways and wind gusts are either not recorded or not specifically correlated to wind data within hourly or special weather observations. However, Dr. Trani's historical analysis shows that strong winds (above 17 knots) favoring Runways 14/32 (140 to 160 degrees and 320 to 340 degrees) are likely to occur 69.94 hours annually (nearly 3 days each year, though not all at once). Without extensive additional analysis, one can only speculate the frequency within that time when the other constraints might eliminate the ability of aircraft to land or depart. It will almost certainly occur, as will pilots attempting to land with aircraft performance limitations pushed to their limits.

This is not insignificant. As the airport with the highest volume of aircraft operations in the entire world, the impact of not having usable runways for hours (or even days) on end is substantial. Such restrictions to capacity, albeit temporary can quickly escalate to hundreds or thousands of hours of lengthy flight delays, mass cancellations and the inability to promptly transport people or cargo through O'Hare. If sustained, the ability of smaller alternate airports to accommodate and service diversions, such as Rockford, Milwaukee, Madison and Indianapolis, becomes impractical. The airspace and air traffic system can become strained, particularly if occurring simultaneously with other complex conditions, such as thunderstorms or snowstorms. The FAA has an efficient traffic management system in place that can force arriving aircraft to be held or metered before departing for ORD. But if the runways available are not adequately oriented into the wind, all aircraft could be held, waiting for more favorable winds or conditions.

4. Converging Runway Operations Rule Changes Suddenly Constrain ORD Departures

Runway 32L historically has been used as a primary departure runway (especially Runway 32L from Intersection T10). In April 2014, following the nationwide implementation of a procedure known as converging runway operations (CRO), departures from Runway 32L were dramatically reduced. Though there was considerable debate and disagreement, FAA Headquarters chose to implement a modified interpretation of separation requirements that adversely affects the simultaneous usage of Runway 32L, Runway 27L and 27R. This also impacts departures from Runway 4L, though not significant in this discussion.

These changes were made by the FAA following a recommendation from the National Transportation Safety Board, concerned with separation incidents at several other airports involving rare but unexpected arrival go-arounds to one runway, not being

positively controlled and separated from departures on another runway[11]. This impacted operations on runway ends within 6,000' of one another. The end of Runway 32L and 27R were affected, since these are 5898.4' apart, or within just 102' of being exempt from this restrictive procedure. The FAA has stated that reducing runway length to circumvent this restriction is not an option.

Runway 14R/32L does not intersect any other runway, meaning that it was an independent, or "free roll" operation until CRO. Runways 32L, 27L and 27R must now be operated as if they actually intersect. The intersecting runway rule requires a Runway 32L departure to be past both Runway 27R and 27L extended centerlines prior to a 27L or 27R arrival reaching the approach end threshold of those runways. This is almost impossible to manage during busier arrival traffic periods. In response, O'Hare Air Traffic Control Tower has essentially abandoned the routine use of Runway 32L. Now, more than 90% of aircraft departures in west flow are directed to Runways 28R and 22L.

Since the opening of runway 27R (the far north runway) the usage of Runways 14L/32R has also diminished. Runway 14L/32R intersects two other runways (9L/27R and 9R/27L- see Exhibit 1). This precludes use of Runway 14L/32R simultaneously with those runways in either a full west or east flow operation, unless traffic on the other two runways are held. Occasionally during light traffic periods, it is feasible to briefly slow traffic to the other runways to allow an isolated operation on Runway 14L or 32R, such as with an emergency or for a VIP operation.

5. Additional Benefits if Runways 14/32 are kept open

Even though current usage is infrequent as measured by duration or traffic volume, having use of these runways is operationally advantageous and provides a viable option that otherwise would not exist. For instance, there are situations in which a few flights that cannot accept a borderline crosswind or tailwind can easily be segregated and the primary runway configuration kept in place. Another beneficial option during west flow operations is to carefully manage the use of Runway 27R (the far north runway), which is already used as an "overflow" arrival runway. Many times during the day- such as during slower arrival traffic periods- it is unused. Chicago TRACON (Elgin, IL) Controllers favor assigning arrivals to the "inboard" runways, closest to the terminal, when only two arrival runways are needed. During these times the tower can use runway 32R for departures, which relieves pressure off of Runways 22L and 28R. Even

11. In response to NTSB recommendation A-13-024, the FAA initially circulated proposed CRO rulemaking to include runway ends within *two* nautical miles. Following significant opposition from airports, airport users and local air traffic facilities, the FAA revised that criteria and reduced affected runways to those converging within *one* nautical mile (6000').

though Runway 32R intersects with Runway 27L, it is manageable with careful timing of Runway 32R departures.

Use of Runway 32L for departures (with Runway 27R inactive) is also an option, though still affected by CRO. There is existing technology that would enhance this operation, the most common of which is known as the Arrival/Departure Window. This assists controllers to optimize the timing of departures using a technological enhancement to the tower radars, minimizing losses in efficiency while still precluding potential conflict with converging arrivals that might go-around. If Runway 14R/32L is kept open, it could then be used for some departures during periods of light arrival traffic, providing a shorter taxi for most aircraft. It is not uncommon for air traffic at many locations to alternate configurations based upon traffic volume patterns for the best efficiency.

Having “extra” runways can enhance air traffic operations in other ways. For example, Runways 14/32 can be used during snow events to stage the large contingents of equipment needed to keep the runways and taxiways open, without blocking ramps or taxiways. ORD now has limited ability to efficiently manage traffic with a runway closure (i.e., pavement failure or disabled aircraft on Runway 28R or 22L). Runways 14/32 can be used to land emergency aircraft that sometimes have mechanical issues preventing them from clearing a runway after landing, or contaminating a busier runway with hydraulic fluid, reducing the urgency of the subsequent cleanup. Even if a runway is not being used for arrivals or departures, it can still be used for taxiing aircraft or to park airplanes encountering weather delays or gate holds. The OMP plan includes closing many of the large hold pads on the existing airport. Leaving each of the diagonal runways open provides excellent alternatives as these hold pads close.

It is important to note that preserving the 14/32 runways does not interfere with construction of the Western terminal.

6. Balance Noise Impacts

Without Runways 14/32, even during the “Fly Quiet” overnight hours, ORD will use a parallel east-west operation, which concentrates noise during this especially sensitive period entirely on the east and west sides of the field. Aggravating the noise balance is the fact that the far north and south side runways (Runways 9L/27R, pending 10R/28L) are not open during “Fly Quiet” hours. Portions of those runways are not visible from the center tower. If the tower cannot see any part of a runway, the runway is considered not usable. For this reason the FAA has built two separate, smaller towers to work these two runways and the surrounding taxiways. The two smaller towers are closed during the overnight hours. Most of the communications, lighting and other equipment are controlled from the center tower, which requires the overnight operations to be run from that facility. Although Runways 4L/22R and 4R/22L are often available, these runways are short (7500’) and often not long enough for the wide body cargo traffic that is common overnight.

During overnight ("Fly Quiet" program hours, 10pm to 6am), normally only two runways are needed- one for arrivals and one for departures. During this time, either or both Runways 32R and 32L can be used without restriction, since most other runways are closed and CRO is not an issue. A typical overnight configuration with west winds is Runway 28C or 28R for arrivals and Runway 32R or 32L for departures. Runway 32R has extra value because it is 10,000' long, enough for wide-body, heavy jet departures, whereas several of the other runways are shorter.

7. Performance Metrics and Capacity

As expected, O'Hare's runway capacity initially increased following the opening of Runways 9L/27R, 10C/28C and the extension of Runway 10L/28R. Weather delays have trended downward, though certainly not by the 95% that Governor Ryan suggested when announcing his support for the OMP in October 2001 (see Exhibit 3, attached hereto)[12]. More recently, departure capacity gains have been sharply reduced by CRO, as has overall efficiency during east flow from the surface issues near the approach end of Runway 9R.

Average taxi-out times for departing traffic at ORD had generally been improving following the opening of Runway 9L/27R in 2006. But for the past several years, average taxi-out times have noticeably increased- from an average of 16.36' per aircraft in 2010 to 17.85' per aircraft in 2014, or in total, more than 10,950 additional hours of annual taxi-out time[13]. The current airport layout and CRO have constrained nearly all departures during West-flow to just two runways. (See Exhibit 4, attached hereto).

It has become apparent, however, that O'Hare's greatest capacity deficiency is not its lack of runways, but rather a shortage of available ramps, gates and terminals. This is frequently compounded by the airport's decision not to deice aircraft remotely, as practiced at nearly every other major airport. Delays for inbound aircraft often exceed 60 minutes while waiting for a gate to vacate. Clearly, this degrades customer satisfaction, adversely impacts airline operating costs, crew duty times, increases adverse environmental emissions and increases complexity for air traffic operations.

ORD arrivals are often subject to an extensive taxi-in after arrival, especially when landing on Runway 9L/27R. Worse, the average taxi-in times at ORD, which includes time spent waiting for occupied gates, has sharply increased- from 8.78 minutes per aircraft in 2010 to 12.24 minutes per aircraft in 2014, or in total, more than 25,400 annual hours of additional taxi-in time[14]. (See Exhibit 5, attached hereto). Other metrics measuring ORD's operational performance have shown similar trends. In the period

12. Annual comparisons of weather delays can be affected by such factors as overall traffic, scheduling, cancellations, construction, variances in severe weather and system performance.
13. Source: FAA, Air Traffic Activity System and Aviation System Performance Metrics.
14. Source: FAA, Air Traffic Activity System and Aviation System Performance Metrics.

4/1/14 to 3/31/15 vs. the same period in 2010-2011, cancellations at ORD increased by more than 21%[15].

In 2014, Runway 14R/32L was closed most of the year, due to a nearby taxiway construction project. This foretold some of the possible impact that may develop if Runways 14/32 are closed permanently. Diversions occur when an aircraft inbound to an airport instead diverts to another airport, typically because conditions at the intended destination are too adverse, including unfavorable wind or runway conditions. In the calendar years 2010 through 2013, O'Hare averaged a total of 998.5 arrival diversions annually. In 2014, there were 1,453 diversions, an increase of 45% over the previous four-year average[16]. The FAA does not record precisely how many of those diversions might have been affected by the closure of Runway 14R/32L, or by air traffic using runways or a configuration more favorably aligned with the wind.

8. Recommendations

- Immediately suspend and re-evaluate plans to close Runway 32R/14L and Runway 32L/14R, or to build Runway 27C/9C.
- Reevaluate runway alternatives considering major new issues not addressed in OMP planning including but not limited to:
    - Converging runway operations in collaboration with ORD Air Traffic Experts and FAA Headquarters;
    - Address surface operation limitations under active approaches in collaboration with ORD Air Traffic experts;
    - Capacity gains possible from NextGen precision navigation, and
    - Alternative analysis to determine the optimum runway configuration for safety, capacity and balancing noise impacts through collaborative community engagement.

15. Cancellations can vary based upon weather and unique situations, such as the October 2014 sabotage of a local air traffic control facility, as well as by operator (airline) business decisions.
16. Source: FAA, Air Traffic Activity System and Aviation System Performance Metrics.

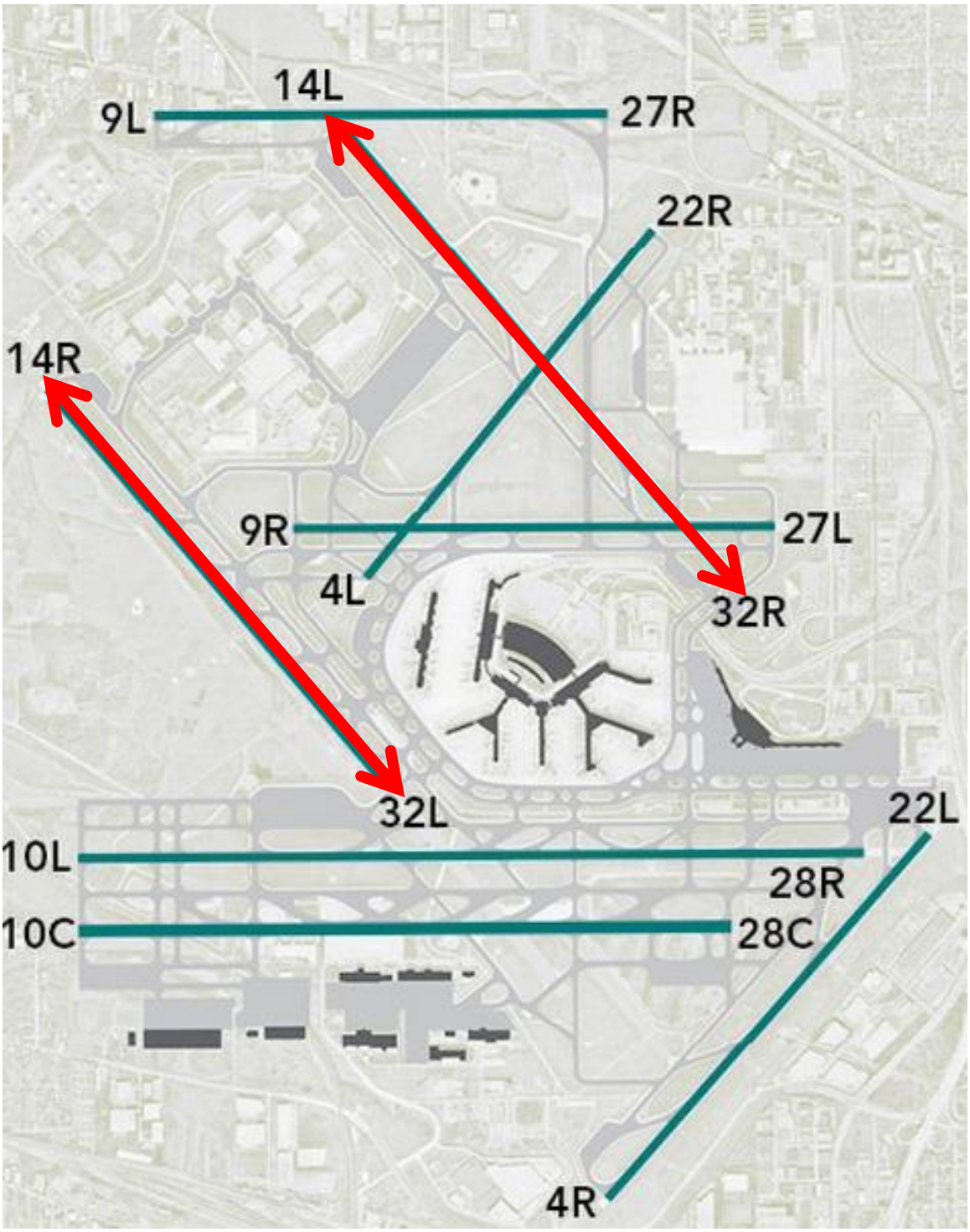

Exhibit 1: Existing ORD Runway Layout (May 2015), source: City of Chicago

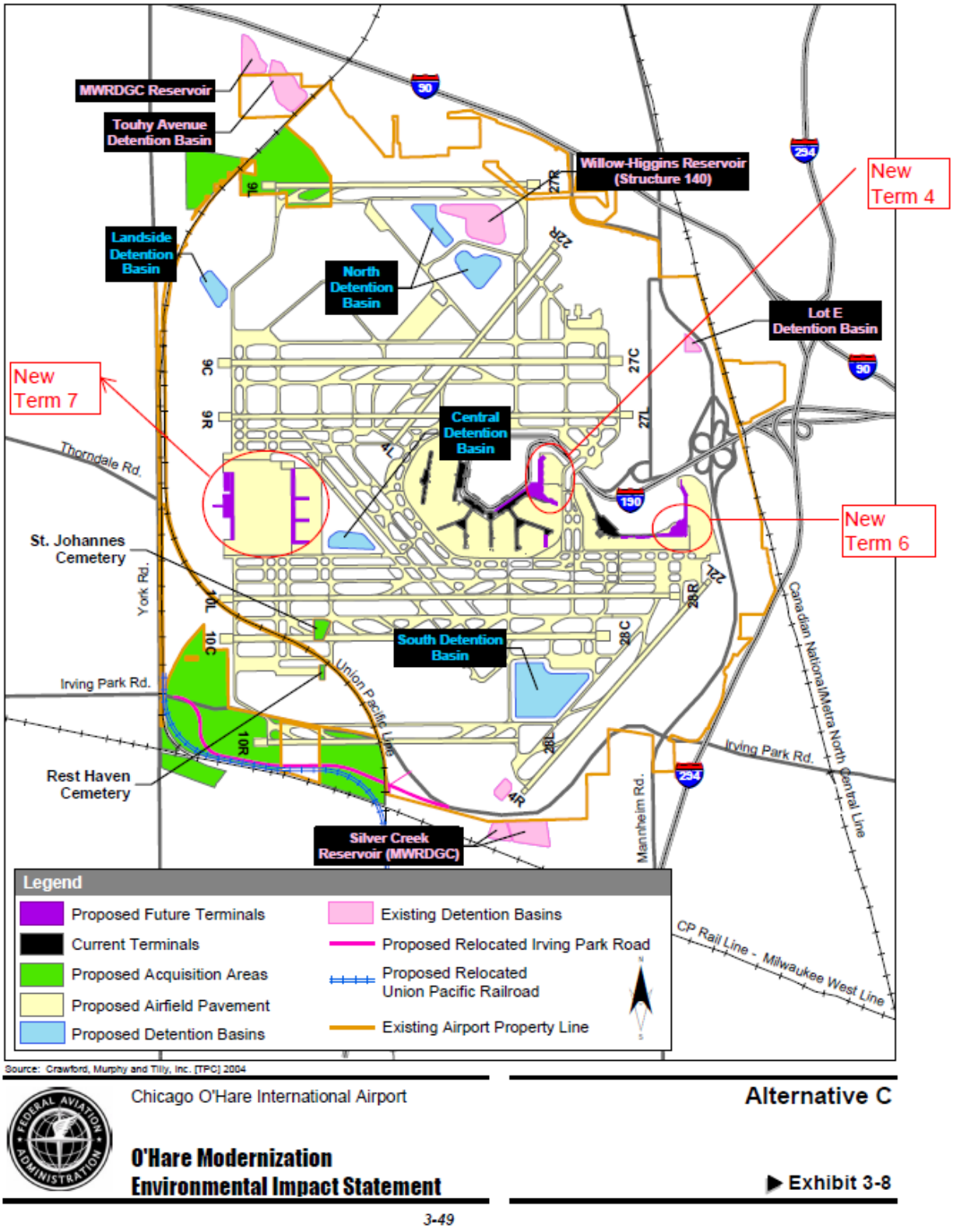

Exhibit 2: Proposed "end state" ORD runway layout (~2020), source: City of Chicago.

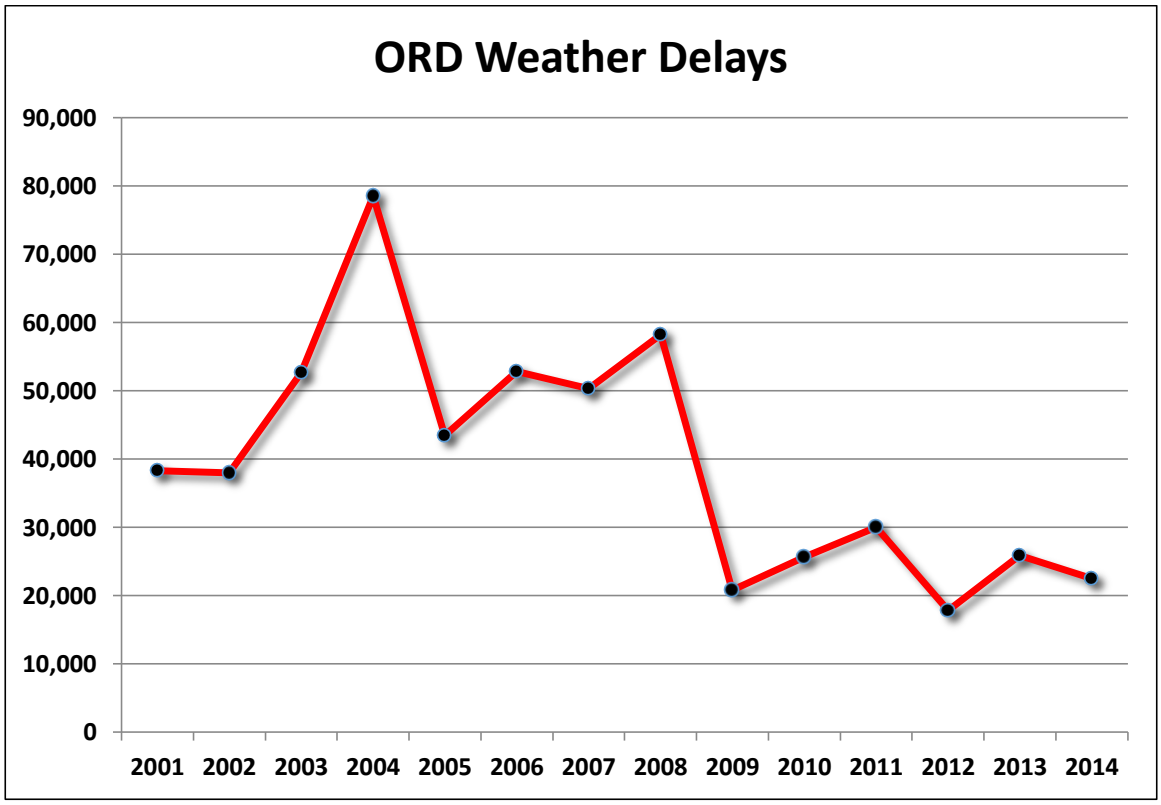

Exhibit 3: Total annual O'Hare weather delays. Source: FAA, Aviation System Performance Metrics (ASPM)

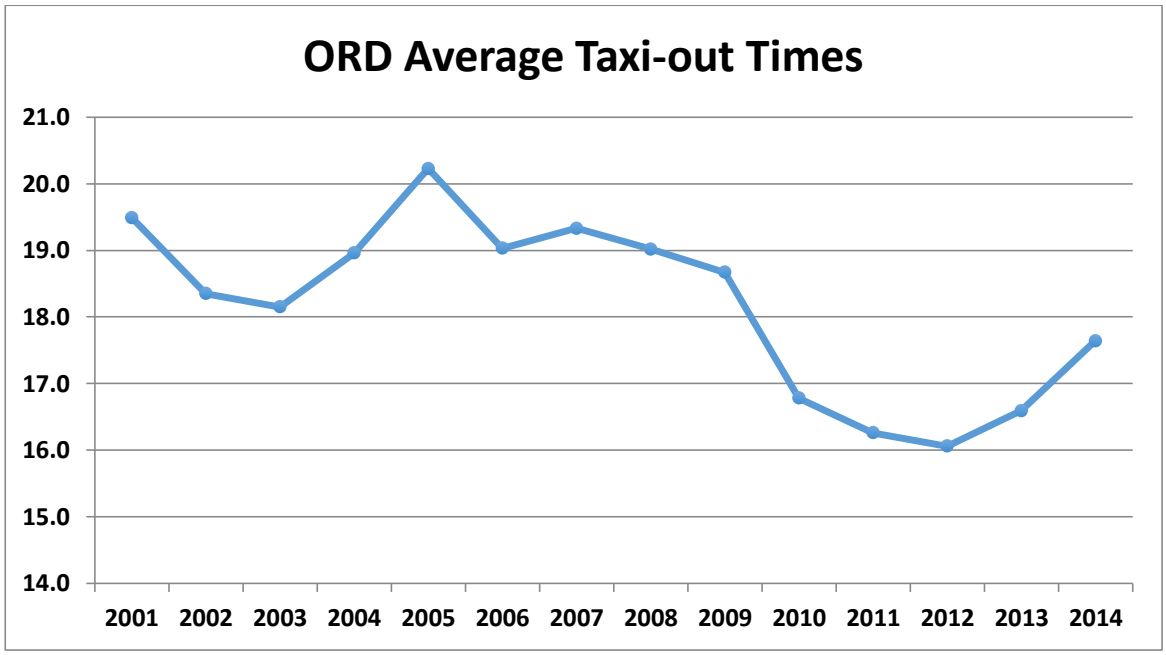

Exhibit 4: ORD Annual Average Taxi-out Times. Source: FAA, Aviation System Performance Metrics (ASPM)

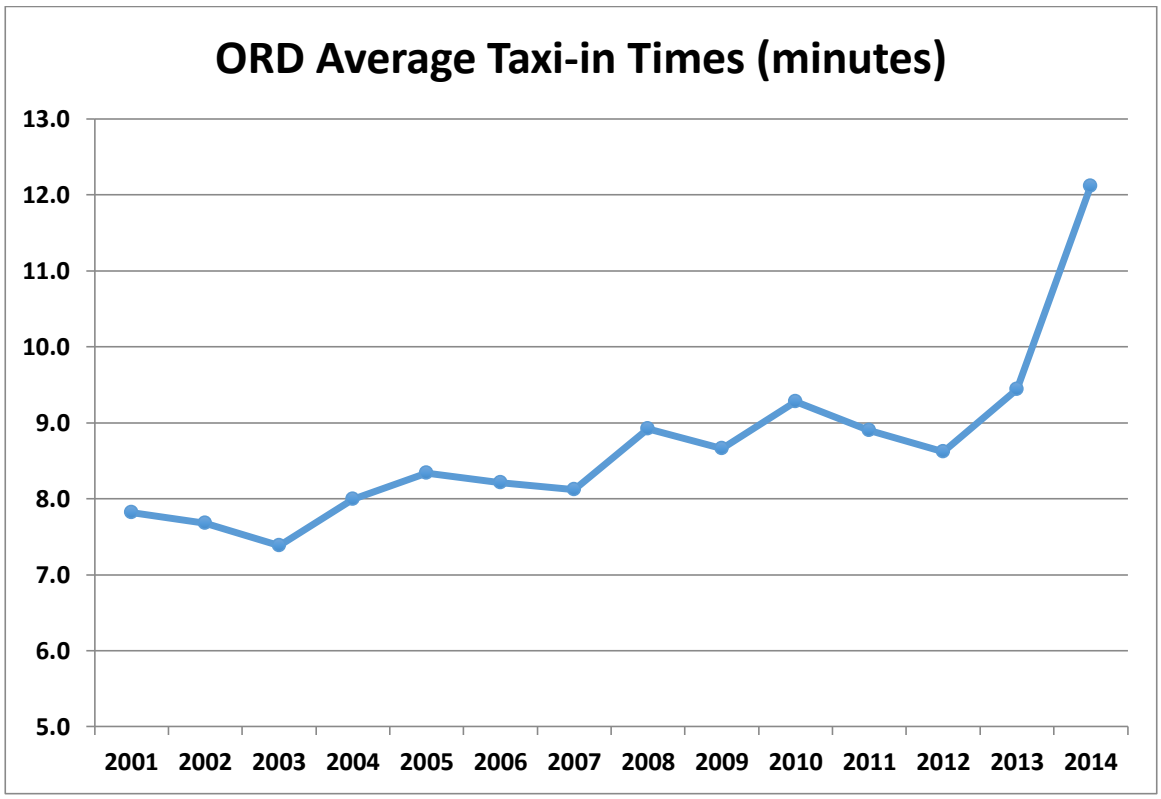

Exhibit 5: Annual Average Taxi-in Times. Source: FAA, Aviation System Performance Metrics (ASPM)

Exhibit 6: THE JDA TEAM

Author:

Rob Voss Senior Air Traffic Operations Subject Matter Expert (SME), is a JDA associated consultant and former career FAA Air Traffic Control Specialist, Operations Supervisor, Quality Assurance and Training Specialist, Plans and Procedures Specialist, Air Traffic Manager, Integration and Efficiency Specialist and finished his FAA career as a System Operations Senior Advisor. Rob spent more than 26 years with the FAA including assignments at Chicago Midway (MDW), San Francisco (SFO), Santa Rosa (STS), Scottsdale (SDL), San Carlos (SQL) and the Midwest Tactical Operations office. While working for several years outside of the FAA, Rob was an Air Traffic Consultant to the Deputy Airport Director (Noise Abatement) at SFO, where he provided analysis, advice and education involving aircraft noise and air traffic procedures and was the Project Manager for a FAR Part 150 noise exposure map update. He has also served as a contractor and Air Traffic Analyst at NASA-Ames Future Flight Central research and simulation facility.

Contributing:

Dr. Antonio A. Trani, is a JDA associated consultant and Professor with the Department of Civil and Environmental Engineering at Virginia Tech University and is Co-Director of the National Center of Excellence for Aviation Operations Research (NEXTOR). He has been the Principal or Co-Principal Investigator on 68 research projects sponsored by the National Science Foundation, Federal Aviation Administration, National Aeronautics and Space Administration, National Consortium for Aviation Mobility, Federal Highway Administration, and the Center for Naval Analyses. Dr. Trani has provided noise, capacity and safety consulting services to the Norman Manley International Airport, Punta Cana International, National Institute for Aerospace (NIA), Xcelar, Quanta Technologies, Los Angeles World Airport, Charles Rivers Associates, Boeing Phantom Works, Civil Aviation Administration of China (CAAC), British Airports Authority (BAA), SEATAC Airport Authority, Louisville International Airport, Delta Airport Consultants, Celanese, and the MITRE Corporation.

Dr. Sanford Fidell, is a JDA associated consultant and owner and President of Fidell Associates which provides consulting and research services and litigation assistance in environmental acoustics, transportation noise, and effects of noise on individuals and communities. He is the U.S. Representative to International Standards Organization (ISO) Technical Advisory Group on Community Response Questionnaire Standardization and to ISO Working Group 45 on Community Response to Noise. Dr. Fidell is member of the Acoustical Society of America and the Technical Committee on Noise. He was on the Design Review Group for the FAA's Integrated Noise Model software. Dr. Fidell has provided consulting services to community, airport and government agencies involved in aircraft noise controversies and assessments and disclosures of aircraft noise impacts and has consulted on land use planning related to

aircraft noise regulation. He is active in international standardization efforts for prediction of aircraft, rail and road noise impacts.

Dr. David Dubbink, is a JDA associated consultant and an Environmental Planning and Noise Management Specialist. He holds a PHD from UCLA in Urban Planning and Environmental Management. He is the designer and developer of ISIS (the Interactive Sound Information System). Dr. Dubbink is a member of the Acoustical Society of America, Institute of Noise Control Engineering, International Association for Impact Assessment and the Transportation Research Board, Committee A1F04, Transportation Related Noise and Vibration. He has provided training and consulting services on noise management to over 80 organizations worldwide.

Craig Burzych is an Air Traffic Operations Specialist, a JDA associated consultant and former career FAA Air Traffic Control Specialist. He spent 24 years working at the O'Hare Control Tower and 4 years working in the Chicago Midway Tower. He was detailed annually to lead the FAA Air Traffic Control support for the annual EAA Oshkosh "fly In" the single largest aviation show and exhibit held in the U.S. Chuck served as President of the National Air Traffic Control Association (NATCA) (Chicago ORD) 9 years and also was a NATCA Aviation Safety Inspector and a member of the FAA Runway Safety Action team for the Great lakes Region.

Cynthia Schultz PE, AAE is JDA's Vice President of Airports where she manages the airport line of business including, airport Safety Management System services, airport sustainability, airport strategic planning, airport security, facilitating new technology/products for airports, training for airports and airlines, airline negotiation and development of support services. Before joining JDA Cynthia was the Airport Director of Great Falls International Airport where she directed and led all airport operations, maintenance, administration, finances, security and support services including project management of engineering, architectural and construction, negotiation and administration of leases and concessions, safety, certification, design, construction and funding issues.

Joe Del Balzo, JDA Founder and President, served as the highest-ranking career professional (Acting Administrator) in the Federal Aviation Administration (FAA). Both in his long career with FAA (where he also served as FAA's Executive Director of System Operations, Executive Director for System Development, Director of the Eastern Region and Director of the FAA Technical Center) and in his subsequent private role as an aviation consultant, he has earned wide respect for his expertise in a wide range of aviation issues.