SCT

SECRETARÍA DE COMUNICACIONES Y TRANSPORTES

Agencia Federal de Aviación Civil

ANÁLISIS DE IMPACTO REGULATORIO

PROY-NOM-091/2-SCT3-2018

ADJUNTO 7.- COSTOS Y BENEFICIOS

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PARTE A.- INTRODUCCIÓN

Los controladores de tránsito aéreo se enfrentan a un reto particularmente al vigilar a un número creciente de aeronaves a través de las aerovías, utilizando el radar terrestre, el cual es limitado y no tiene la capacidad de rastrear aeronaves en tiempo real. Con solo una vaga idea de la ubicación precisa de cada avión en particular, los controladores aéreos a menudo mantienen un espacio de separación entre aeronaves, como medida de precaución que obliga a los pilotos a tomar rutas más largas y requieren de un mayor consumo de combustible.

Es importante comentar que las aeronaves no vuelan directamente de su punto de origen a su destino, si no que vuelan a través de corredores aéreos (aerovías) cruzando por puntos intermedios hasta llegar a su destino.

A través del Sistema de ADS-B Out, se podrán llevar acabo la vigilancia de aeronaves comerciales en tiempo real, lo que permitiría a los controladores aéreos brindar espacios más cortos entre de manera más estrecha las aeronaves y darles a los pilotos la capacidad de seleccionar mejores rutas y altitudes. El resultado de la implementación del ADS-B se traduce en tiempos de vuelo más cortos, menor consumo de combustible, emisiones de CO_2 reducidas, viajes más confortables y un ahorro importante de millones de dólares anuales para los Concesionarios, Permisionarios u Operadores Aéreos.

Para gestionar el tránsito aéreo de manera óptima, los controladores aéreos y los pilotos requieren conocer la ubicación precisa de la aeronave, conociendo los permisos, las altitudes y las velocidades de cada aeronave en un área determinada, mantener una comunicación confiable.

En caso de que alguno de estos elementos deje de funcionar, se debe recurrir a otro tipo de soluciones que permitan operaciones seguras, como espaciar las aeronaves a mayor distancia para asegurarse de que no vuelan demasiado cerca una de otra.

El ADS-B a diferencia del radar terrestre proporciona un nivel de vigilancia mejorado, ya que la posición de las aeronaves aparece en tiempo real.

El ADS-B Out de una aeronave, envía automáticamente los datos de vuelo pertinentes a los receptores en tierra dos veces por segundo. En otras palabras, las computadoras de la aeronave se comunican automática y continuamente con los controladores aéreos en tierra, lo que proporciona un grado sin precedentes de vigilancia en tiempo real.

Para la publicación del Proyecto de Norma Oficial Mexicana, sobre la instalación del equipo ADS-B Out, se han considerado diversas fuentes de información, así como escenarios económicos que aporten beneficios, derivados de la implantación del equipo en las aeronaves que operan en el espacio aéreo nacional.

En el presente adjunto de análisis de costos y beneficios que se generan con la emisión de la Norma Oficial Mexicana se tiene la estimación de:

- La inversión que se tiene que hacer en la instalación / actualización del ADS- Out.
- El impacto económico estimado a mediano y largo plazo que tendrá efecto una vez instalado el equipo y los efectos de su funcionamiento sean tangibles.
- La estimación del potencial beneficio económico, como resultado de la instalación del equipo ADS-B Out en las aeronaves.
- El incremento del nivel de seguridad en la operación; considerando que la vigilancia de las aeronaves se mantendría constante.

Antes de comenzar la cuantificación económica, es necesario considerar los siguientes supuestos económicos:

1. La industria del transporte aéreo es una industria global (conectada con el resto del mundo), por lo que las repercusiones económicas de indicadores macroeconómicos pueden afectar el desempeño financiero de este sector, estas variables se consideran exógenas al análisis de beneficios planteados en este adjunto y su efecto no es considerado.
2. **El equipo ADS-B coadyuvará a la industria aérea a la reducción de tiempo operación de las aeronaves, lo que genera un consumo menor de combustible** y reducción de jornadas en su personal.

En específico, el presente estudio de costos-beneficios económicos, se centrará en la reducción de tiempo de vuelo y consumo de combustible, lo que genera un ahorro significativo para los permisionarios, concesionarios y operadores aéreos, una vez que sus aeronaves tengan instalado el equipo ADS-B Out.

La información aquí plasmada tiene un carácter económico de proyección y ponderación, por lo cual, es necesario que su entendimiento de inclusión regulatoria sea considerado como tal.

PARTE B.- DESARROLLO.

1.- ANÁLISIS DE COSTOS.

1.1.- Definición de Agentes Económicos.

Para el desarrollo de costos originados por la implementación del Anteproyecto, se tomó como base lo contenido en su numeral "5. Requerimientos de Uso e Instalación del ADS-B Out.", la cual se visualiza a continuación:

A continuación, en la tabla 1, se exponen los diferentes costos que se generan con la instalación del equipo ADS-B Out al dar cumplimiento a la Norma Oficial Mexicana:

#	Aeronave	Matricula	Taller	Modificación	Costo
1	**Cessna 525C Citation Jet**	XA-GZZ	San Antonio Citation Service Center	SB 525C-34-09R02 Actualización de ADS-B OUT	**$ 16, 012 USD**
2	**Challenger 604**	-	Bombardier	-	**$ 33, 542 USD**
3	**Embraer Legacy 500**	XA-COS	Embraer Executive Jet Services	SB 550-34-0002 Actualización de DO-260A a DO-260B	**$ 46, 330 USD**
4	**Cessna 550**	-	SoCal Jets	-	**$ 63, 965 USD**
5	**Cessna 680 Citation Sovereign**	XA-HIT	Cessna Aircraft Company	SB 680-34-33 R1 Actualización de ADS-B OUT	**$ 72, 435 USD**
6	**Gulfstream G350**	-	Aircraft Service Change 079	-	**$ 76, 500 USD**
7	**Dassault Falcon 2000EX**	XA-CDT	Dassault Falcon Jet Corp.	STC ST02962NY-D Actualización de ADS-B OUT	**$ 77, 600 USD**

Tabla 1.- Costos de la Instalación del ADS-B Out

Véase el Apéndice A.- Documentación de los costos de instalación/ actualización del ADS-B Out, para referencia de los costos.

De la tabla 1, podemos apreciar la variación de los costos que tendrá la instalación del equipo ADS-B de acuerdo con el servicio y aplicación de la aeronave; por esta razón en la tabla 2 .- Promedio de costos, se tiene un estimado del costo para cada regulado (Operadores aéreos, Permisionarios, Concesionarios), quedando de la siguiente forma:

Regulado	Costo unitario estimado
Operadores aéreos	**$ 16, 012 USD**
Permisionarios **(promedio de aeronaves 2 y 3, tabla 1)**	**$ 39, 936 USD**
Concesionarios **(promedio de aeronaves 4, 5, 6 y 7, tabla 1)**	**$ 72, 625 USD**

Tabla 2.- Promedio de costos

En la tabla 3 .- Cantidad de aeronaves, **se muestran el número de aeronaves estimado** que actualmente operan en el Espacio Aéreo Mexicano.

Regulado	Número
Operadores aéreos	317
Permisionarios	903
Concesionarios	349
Total	**1,569**

Tabla 3.- Cantidad de aeronaves

De lo anterior:

Regulado	Número de equipos ADS-B Out por instalar	Costo unitario estimado (USD) por instalación de ADS-B	Costo por instalación (USD)
Operadores aéreos	317	$ 16, 012	$5,075,804.00
Permisionarios	903	$ 39, 936	$36,062,208.00
Concesionarios	349	$ 72, 625	$25,346,125.00
TOTAL	**1,569**	**$128,573.00**	
		TOTAL	**$66,484,137.00**

Tabla 4.- Costos de instalación por regulado

Por lo tanto, se tiene que el **costo total estimado** por la instalación del equipo ADS-B Out en las aeronaves que operan en el país será de **$ 66,484,137.00 USD.**

Derivado de lo anterior, se elabora l**a Tabla 5.- Proyección de costos, en la cual se hace la estimación a 10 años**, es importante comentar que la inversión que se realicé en la instalación / actualización del equipo ADS-B Out solo se realiza en una sola exhibición y al ser un requerimiento internacional solicitado por diversas Autoridades Aeronáuticas de otros países, todas las aeronaves nacionales o extranjeras estarán equipadas, por lo que no se necesita realizar un nuevo costo del equipo.

Periodo	1	2	3	4	5	6	7	8	9	10
# de Aeronaves a equipar	1,453.00	0	0	0	0	0	0	0	0	0
Proyección a 10 años.										
Proveedor de Servicios	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**	**Y7**	**Y8**	**Y9**	**Y10**
Operadores Aéreos	$ 5,075,804	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Permisionarios	$ 36,062,208	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Concesionarios	$25,346,125	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Subtotal costos	**$66,484,137**									
Factor de descuento	0.893	0.797	0.712	0.636	0.567	0.507	0.452	0.404	0.361	0.322
Costo total con descuento (USD)	**$59,360,837**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Tabla 5.- Proyección de Costos.

Tomando en cuenta la proyección y el factor de descuento se obtiene un total de:

Valor Presente Neto del Costo = $ 59,360,837 USD.

Del VPN del costo antes señalado, **es necesario efectuar un reajuste para la disminución de las 1,569 aeronaves**, de acuerdo a los siguientes factores estimativos:

a) Considerando que el requerimiento de instalación de ADSB-Out se deriva de un cumplimiento internacional para el Año 2020 (ver adjunto 6), **países como Estados Unidos de Norteamérica, así como los pertenecientes a la Unión Europea, ya cuentan dentro de su legislación con el requerimiento de instalación del ADS-B Out para las aeronaves que operen en dichos Estados.**

   Para el caso de los Estados Unidos de Norteamérica, el requerimiento de instalación del ADS-B Out comenzó a partir del 1 de enero de 2020 (adjunto 6). Por otra parte, el marco regulatorio de la Unión Europea obligará a tener instalado el ADS-B Out a partir del 7 de junio del 2020 (adjunto 6.1).

   Es importante señalar que **todas las aeronaves que cuenten con la instalación del ADS-B Out y que sobrevuelen en los espacios aéreos de los Estados antes señalados, a partir de las fechas de cumplimiento indicadas, se les dará preferencia en su correspondiente gestión de tránsito aéreo.**

   Por lo anterior, a nivel nacional, **los Concesionarios, Permisionarios y Operadores Aéreos se han dado a la tarea de equipar sus aeronaves con esta nueva tecnología con el objeto de no ser diferenciados en el espacio aéreo bajo la jurisdicción de otros estados**. Prueba de esta aseveración es que **sin aún haberse publicado la NOM que nos ocupa, muchos Concesionarios,**

Permisionarios y Operadores Aéreos se han dado a la tarea de equipar sus aeronaves con esta nueva tecnología, por lo cual esta Autoridad Aeronáutica ya ha autorizado los correspondientes trabajos de instalación del ADS-B Out el extranjero de dichas aeronaves; para pronta referencia, ver adjunto 16.

b) Se estima que para el 1 de enero del 2022, el porcentaje de aeronaves pertenecientes a Concesionarios, Permisionarios u Operador aéreos que deban instalar el ADS-B Out sea el mínimo derivado a:

   i. Que el requerimiento de la propuesta de NOM que nos tañe es para el 1 de enero del 2022, mismo que tiene un desfase de 2 años con respecto al requerimiento internacional, lo que propiciará que de conformidad a lo señalado en el inciso a) antes mencionado, los Concesionarios, Permisionarios u Operadores aéreos equipen gradualmente sus aeronaves, estimando que para el 2022, solo exista un número reducido de aeronaves que no cuenten con el equipamiento del ADS-B Out.
   ii. Que en la actualidad, la mayoría de las aeronaves que conforman la flota aérea nacional, son de reciente generación, mismas que ya traen de fábrica el equipamiento del ADS-B Out.
   iii. Que la mayoría de los Concesionarios y Permisionarios arrendan las aeronaves, por lo que deben de cumplir con las cláusulas de los contratos de arrendamiento que exigen al arrendatario, mismo que exige, a fin de que la aeronave se encuentre en condiciones de aeronavegabilidad (es decir en condiciones seguras para volar), el cumplir con los requerimientos de las autoridades de aviación civil del estado de diseño de la aeronave (país fabricante de la aeronave), siendo en su mayoría fabricantes vigilados por la "Federal Aviation Administration" (FAA) o "European Aviation Safety Agency" (EASA). Por lo anterior, el no volar hacia Estados Unidos o Europa, no exime a los explotadores aéreos de no cumplir con los requisitos de equipamiento actuales.
   iv. Que se estima que los Permisionarios y Operadores Aéreos, darán de baja las aeronaves antiguas, toda vez que actualmente la normatividad a nivel internacional es cada vez más estricta en el tema de equipamiento (FDR, CVR, TCAS entre otros equipos), por lo que el costo de actualizar las aeronaves de este tipo es sumamente elevado, siendo no redituable.

Por los factores estimativos antes expuestos, esta Autoridad Aeronáutica estima que para el 1 de enero de 2022, fecha en la será una obligación el requerimiento de equipamiento ADS-B, de conformidad al requerimiento de equipamiento ADS-B del Proyecto de NOM en cuestión, ya se contará con el equipamiento del 98.79% de aeronaves pertenecientes a Concesionarios, Permisionarios y Operadores Aéreos; esto conlleva a que del VPN calculado anteriormente se tenga que ajustar con la finalidad de integrar la diferencia del estimado de aeronaves equipadas, por lo que el VPN de Costo queda en:

Valor Presente Neto del Costo = $ 718,266.12 USD.

2. ANÁLISIS DE BENEFICIOS.

Son diversos los beneficios que se generan a partir de la instalación del ADS-B Out en las aeronaves de los Permisionarios, Concesionarios y Operadores Aéreos, tales como:

2.1 Mejora la administración de las tripulaciones de vuelo.
2.2 Aumento en el nivel de seguridad.
2.3 Reducción en el consumo de combustible.

A continuación, se desarrollan cada uno de los beneficios anteriormente mencionados, en los cuales se explica a mayor detalle las ventajas que se obtienen una vez que entre en vigor la Norma Oficial Mexicana.

2.1 Mejora la administración de las tripulaciones de vuelo.

En cuanto a las tripulaciones de vuelo, si se reducen los tiempos de trayectoria y aproximación, esto permitiría que las tripulaciones puedan cubrir mayor número de vuelos o mayor tiempo disponible para alguna otra función que se requiera.
Lo cual provocaría una mejor distribución de las cargas de trabajo entre las tripulaciones de vuelo, permitiendo que se tenga una cantidad de personal adecuado al número de vuelos.

2.2 Aumento en el nivel de seguridad.

Entre los beneficios que proporciona la instalación del equipo de ADS-B Out en las aeronaves, se encuentra el incremento de la seguridad, centrándose en mantener las vulnerabilidades a un nivel aceptable; estableciendo un marco de referencia común para analizar la seguridad de la aviación, comunicar problemas y determinar prioridades.

Este beneficio lo podemos ver confirmado tomando como referencia la experiencia en Alaska, donde se ha mostrado un aumento en las medidas de seguridad:

- Menor índice de accidentes (para 2005-2009, el índice de accidentes por millón de operaciones fue 30.1% más bajo para aviones equipados con ADS-B Out que para aviones no equipados); y
- Disminución del tiempo de búsqueda y rescate (los datos ADS-B permitieron localizar un vuelo rápidamente y salvar la vida de un piloto).

Lo anterior se menciona en el Apéndice B.- Transforming Air Traffic within the US National Air Space System, del presente, en la página 8.

2.3 Reducción en el Consumo de Combustible

Una vez instalado el equipo ADS-B Out en las aeronaves se presenta una mejora en la operación y vigilancia de los vuelos por parte de los Servicios de Tránsito Aéreo, para reducir la separación entre aeronaves, disminuir los tiempos de vuelo y de espera en la aproximación final hacia el aeropuerto de destino; con todo lo anterior, el tiempo de vuelo es directamente proporcional al consumo de combustible.

De acuerdo con Ross Bowie, director de diseño del servicio de navegación aérea, la introducción del ADS-B ayudará a las aerolíneas a reducir la quema de combustible, "El caso de negocios es muy claro para este [sistema]; ahora tenemos que presionar más" para reducir [los costos]", dice Bowie. Los estudios muestran que solo reducir la separación en el área de la Bahía del Hudson reduciría los costos de combustible de las aerolíneas en aproximadamente $ 9.8 millones al año (Incluido en el Apéndice C.- Nav Canada Aims to cover major routes with ADS-B).

Inherente al beneficio de reducción de consumo de combustible, se encuentra la disminución de las emisiones de CO_2 generadas por las aeronaves.

2.3.1 Estimaciones de combustible

Derivado del punto anterior, a continuación, se proporciona una explicación de los cálculos estimados de los beneficios directos e in directos que obtendrán los Concesionarios, Permisionarios u Operadores Aéreos una vez instalado el equipo ADS-B Out en las aeronaves.

La implementación del sistema de vigilancia del ADS-B, permitirá una optimización del espacio aéreo y las aeronaves podrán operar en niveles más cercanos al óptimo. Por lo tanto, se obtendrá beneficios importantes en el ahorro de combustibles, pero sobre todo se logrará evitar daños al medio ambiente, al reducir las emisiones de CO_2.

Para elaborar los siguientes cálculos tomaremos como referencia un estudio realizado por la Universidad de Purdue, publicado a finales de 2016, en el cual se tomó un aspecto macro de ADS-B basado en el espacio. En este estudio se menciona que si se implementara **una red ADS-B a nivel mundial**, las aerolíneas **podrían ahorrar más de 110 millones de galones de combustible anualmente en 2020** (Véase el Apéndice C).

Calculando esta cantidad con un **precio de combustible de $1.92 USD por galón** (véase el Apéndice D Costo del Combustible) se obtiene el siguiente precio total:

110,000,000 Gal. x $1.92 USD = <u>$ 211,200,000.00 USD / año</u>

De acuerdo con la Organización de Aeronáutica Civil Internacional (OACI), la cantidad de **operaciones a nivel mundial 36,722,000 operaciones** (véase el Apéndice E, Annual Report 2017).

Del total de las operaciones a nivel mundial, México, de conformidad a las Estadísticas reportadas por Servicios a la Navegación en el Espacio Aéreo Mexicano, reportó que tuvo 1,749,638 operaciones aéreas para el 2017 (véase el Apéndice F Operaciones Aéreas en México 2011-2017).

De tal forma que:

Operaciones a nivel mundial 36,722,000 – 100 %

Operaciones en México 1,749,638 – X %

X = 4.764 % de operaciones en México

Por lo tanto, **el total de operaciones aéreas en México corresponden al 4.764 %** del total de operaciones aéreas a nivel mundial.

Resumiendo, en la siguiente tabla 6.- Beneficios de la instalación del ADS-B Out, se establece el ahorro anual de combustible a nivel mundial por el uso del Sistema ADS-B, a México le corresponde el 4.764 % que es su participación a nivel mundial.

	Número de Operaciones	Porcentaje de operaciones	Ahorro (USD)
Mundial	36,722,000	100 %	**$ 211,200,000.00**
México	1,749,638	4.764 %	**$ 10,062,729.31**

Tabla 6.- Beneficios de la Instalación del ADS-B Out

Considerando lo anterior, se elabora la Tabla 7.- Proyección de beneficios, en la cual se hace la estimación a 10 años, como se puede observar en la tabla, los beneficios se irán acumulando año tras año.

Periodo	1	2	3	4	5	6	7	8	9	10
Proyección a 10 años.										
Año	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**	**Y7**	**Y8**	**Y9**	**Y10**
Ahorro de Combustible Anual en México	$10,062,729	$10,502,471	$10,961,429	$11,440,443	$11,940,390	$12,462,185	$13,006,783	$13,575,179	$14,168,415	$14,787,574
Factor de descuento	0.893	0.797	0.712	0.636	0.567	0.507	0.452	0.404	0.361	0.322
Beneficio total con descuento	$8,984,580	$10,502,471	$10,961,429	$11,440,443	$11,940,390	$12,462,185	$13,006,783	$13,575,179	$14,168,415	$14,787,574

Tabla 7.- Proyección de Beneficios

En total se tiene un:

Valor Presente Neto del Beneficio de: $ 121,829,449 USD.

2.3.1.1 Beneficios relacionados con la reducción tiempo de vuelo

En aviación, el tiempo es dinero y con la reducción en el tiempo de vuelo debido a la optimización del espacio aéreo por la utilización del ADS-B, adicionalmente se obtendrán de manera importante ahorros por concepto de mantenimiento, derivado a que los componentes controlados por tiempo (motores y accesorios) extenderán su límite de vida, optimizando los costos derivados por el mantenimiento a las aeronaves de los Concesionarios, Permisionarios y Operadores Aéreos.

3. CÁLCULO DE COSTO/BENEFICIO

Realizando el cálculo en la tabla 8.- Costo-Beneficio, podemos apreciar que el beneficio supera al costo, por lo que nuestra regulación es viable.

Valor Presente Neto	USD	MXN[1]
Beneficio	$121,829,449	$ 2,314,759,525.37
Costo	$718,266	$13,647,056.28
Costo/Beneficio	**$121,111,183**	**$2,301,112,469.09**

Tabla 8.- Costo-Beneficio

1 Se realiza una conversión de 1 USD = 19 MXN.

PARTE C.- CONCLUSIONES

Costos	Beneficios
• Instalación / Actualización del equipo ADS-B Out en las aeronaves de los Permisionario, Concesionarios y Permisionarios.	• Incremento en la operación y monitoreo en vuelo por parte del Servicio de Tránsito Aéreo. • Reducción de distancias entre aeronaves. • Disminución de tiempos de trayectoria y de espera en la aproximación en las operaciones aéreas. • Reducción de consumo de combustible, por lo que también se reducen las emisiones de CO2 de las aeronaves gracias a una eficiencia mejorada. • En cuanto al personal de tripulaciones, si se reducen los tiempos de trayectoria y aproximación, esto permitiría que el personal pudiera cubrir mayor número de vuelos o mayor tiempo disponible para alguna otra función que se requiera. • Incremento de la seguridad, manteniendo un nivel de vigilancia mayor al actual. • Mejor acceso a niveles de vuelo óptimos mediante procedimientos de ascenso/ descenso utilizando ADS-B. • Mejoras de capacidad en determinada ruta aérea. • Seguridad operacional y eficiencia de las operaciones en la superficie. • Reduce potencialmente los tiempos de rodaje al proporcionar a los controladores una mejor conciencia de la situación del tránsito. • Mejora potencialmente la recuperación de la capacidad de aeródromos de complejidad media en condiciones de escasa visibilidad. • Proporciona al controlador conciencia de la situación del tránsito en forma de información de vigilancia. • Podría reducir el número de colisiones en la pista al facilitar la detección de incursiones. • Representa una solución de vigilancia menos costosa para aeródromos

- Como se aprecia en el desarrollo del presente análisis de impacto regulatorio, los beneficios que obtendrán los Concesionarios, Permisionarios y Operadores aéreos, una vez que la Norma Oficial Mexicana haya sido establecida y entre en vigor, serán mayores a los costos generados por la instalación del equipo ADS-B Out en sus aeronaves.
- Desde un punto de referencia económico, comparando la instalación del equipo ADS-B Out y cualquier siniestro proyectado, es evidente que el beneficio es mayor.

ANÁLISIS DE IMPACTO REGULATORIO

PROY-NOM-091/2-SCT3-2018

APÉNDICE A.- DOCUMENTACIÓN DE LOS COSTOS DE INSTALACIÓN/ ACTUALIZACIÓN DEL ADS-B OUT

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Across

SECRETARIA DE COMUNICACIONES Y TRANSPORTES
DIRECCIÓN GENERAL DE AERONÁUTICA CIVIL
DIRECCIÓN GENERAL ADJUNTA DE AVIACIÓN
DIRECCIÓN DE AVIACIÓN
ING. GUILLERMO MAGAÑA HERNANDEZ
P R E S E N T E

Asunto: Autorización de reparación en el extranjero.

LINALOE GARDUÑO BERMUDEZ en representación de la empresa denominada SERVICIOS AEREOS ACROSS, S.A. DE C.V. personalidad que tengo debidamente acreditada, señalando como domicilio para oír y recibir toda clase de notificaciones el ubicado en Nellie Campobello 129 Ed. Navajo Int. 102 Col. Carola C.P. 01180, Ciudad de México; y para los mismos efectos al Licenciado Carlos Narváez Salazar y C. Paloma Belem Oliveros Rodríguez para tramitar y recibir todo tipo de informes, avisos y documentos relacionados con la empresa, con el debido respeto comparezco y expongo:

Que mi representada cuenta con la aeronave marca Cessna, modelo 525C, serie 525C0003, matrícula **XA-GZZ**; próxima a cumplir el tiempo para la realización de los servicios programados:

- **SB 525C-34-09 R02**– BOLETÍN DE SERVICIO NO. 525C-34-09 REVISIÓN 02 – NAVEGACIÓN- INSTALACIÓN DE TRANSPONDER

Debido a lo anterior, solicito de no existir inconveniente sea efectuado el mantenimiento antes descrito con una estima de realización de dichos servicios en 07 días en el Taller Extranjero denominado SAN ANTONIO CITATION SERVICES CENTER,SAT, ubicado en San Antonio Texas.

Por lo anterior, a Usted Ing. Guillermo Magaña Hernández, Director de Aviación, solicito atentamente:

UNICO. - Autorizar que el servicio de mantenimiento se realice en el Taller de Mantenimiento en el Extranjero.

Sin más por el momento y en espera de su atenta respuesta, quedo de usted.

Ventanilla Única de Servicios D.G.A.C.
ENTRADA
01 NOV. 2018
SCT

México, D.F. a 01 de noviembre de 2018.
Por: SERVICIOS AEREOS ACROSS, S.A. DE C.V.
N&G-ACROSS621

Lic. Linaloe Garduño Bermúdez
Apoderada.

SECRETARIA DE COMUNICACIONES Y TRANSPORTES

FORMA IA-50/94-A

APÉNDICE "A" NORMATIVO
SOLICITUD PARA EFECTUAR MANTENIMIENTO A AERONAVES Y SUS COMPONENTES EN EL EXTRANJERO

1.- DATOS DEL SOLICITANTE.

NOMBRE: **SERVICIOS AEREOS ACROSS, S.A. DE C.V.**

DIRECCIÓN: **Juan Salvador Agraz 65, Piso 12, Col. Santa Fe Cuajimalpa, Del. Cuajimalpa de Morelos, Ciudad de México, C.P. 05348**

TELÉFONO: **(555)-6623100** FAX:

2.- DATOS DE LA AERONAVE.

PROPIETARIO O POSEEDOR: **SERVICIOS AEREOS ACROSS, S.A. DE C.V.**

MARCA: CESSNA MATRICULA: **XA-GZZ**

MODELO: 525C T.T. 4043.0 C.T 2831

No. DE SERIE: 525C0003 T.T.U.R.M. ___/___ C.T.U.R.M. ___/___

BASE DE OPERACIONES: Toluca

3.- DATOS DEL COMPONENTE A REPARAR:

NOMBRE	**PLANEADOR**	**MOTOR**
MARCA:	**CESSNA**	**WILLIAMS INTERNATIONAL**
MODELO:	**525C**	**FJ44-4A**
No(S) DE SERIE	**525C0003**	**ENG 1 S/N: 211037** **ENG 2 S/N: 211016**
T.T.	4043.0	**ENG 1:** 4043.0 **ENG 2:** 4043.0
T.U.R.M	/	/

4.- DATOS DEL TALLER AERONÁUTICO EXTRANJERO:

NOMBRE: **SAN ANTONIO CITATION SERVICE CENTER, SAT**

DIRECCIÓN: **SAN ANTONIO TEXAS, 78216**

No. DE PERMISO EMITIDO POR LA AUTORIDAD AERONÁUTICA EXTRANJERA: **FAA: CNQ5918C** CO-032/11

5.- DESCRIPCIÓN TÉCNICA DETALLADA DE LOS TRABAJOS QUE SE PRETENDEN EFECTUAR:

- **SB 525C-34-09 R02**– BOLETÍN DE SERVICIO NO. 525C-34-09 REVISIÓN 02 – NAVEGACIÓN- INSTALACIÓN DE TRANSPONDER ADS-B OUT.

6.- MOTIVO DE LA SOLICITUD: Por días de servicio.

7.- FECHA ESTIMADA DE SALIDA: **21 de NOVIEMBRE 2018**

8.- TIEMPO ESTIMADO DE LA DURACIÓN DE LOS SERVICIOS: **7 días**

9.- NOMBRE Y FIRMA DEL RESPONSABLE O SOLICITANTE: **LIC. LINALOE GARDUÑO BERMUDEZ**

10.-LUGAR Y FECHA: **Toluca, Estado de México a 31 de octubre de 2018.**

- TT: TIEMPO TOTAL DE LA AERONAVE Y/O COMPONENTE.
- ESTA FORMA PODRA OBTENERSE CON LA AUTORIDAD AERONAUTICA MAS CERCANA.
- TURM: TIEMPO DESDE ULTIMA REVISIÓN MAYOR.

Thank you for considering Textron Aviation Inc. to maintain your aircraft. We have a vested interest in making sure you are delighted with your Textron Aviation Service Center experience. As part of our commitment to exceptional service, we submit the following Service Proposal for your review. If any of the services or products described below is not as requested, please contact me immediately for a revision.

NOTE: All currencies are in USD.

Proposal Details

DESCRIPTION	CUSTOMER PRICE
AVIONICS	
Accomplish SB525C-34-09 Rev. 2 ADS-B Out Compliance- UPGRADE Customer Transponder Textron Aviation will comply with SB525C-34-09 Rev. 2 performing all required tasks to make your aircraft ADS-B Out compliant. Your transponder PN 622-9210-409 will be upgraded to ADS-B Out compliant PN 622-9210-501 that meets the regulatory requirements. Includes Parts. Upgrade of customer transponders quoted. Requires 21 to 24 days downtime.	$16,012.00
Subtotal	**$16,012.00**
TOTAL (excludes taxes, supplemental freight and hazmat fees) **Pricing does not include parts unless specific to the line item.**	**$16,012.00**

Price subject to re-evaluation upon inspection of the aircraft.

Proposal Accepted by Customer

By: ______________________________

Printed Name: ______________________

Title: ______________________________

Date: ______________________________
MM/DD/YYYY

Andrew Moss
Service Sales Manager
+1 (713) 567-5045
amoss@txtav.com

CHALLENGER 604

Learjet, Inc.
Bombardier Aircraft Services (BAS) Proposal

Thank you for being our valued customer. We appreciate the opportunity to meet your maintenance needs. This proposal was prepared on **December 8, 2017** for , Aircraft , Registration **XA-**.

CEO
Phone: +011 (52) 55-5293-0563
Mobile: + (521) 5527260937
Fax:
E-Mail:

Gregorio Torres
Learjet, Inc., BAS
Regional Sales Manager
Phone: +011 (52) 81-1811-3571
Mobile: +011 (521) 81-1577-4639
Fax:
E-Mail: gregorio.torres@aero.bombardier.com

ICT17/8/10-604-5578-724-11530, Revision: 1

BAS - Wichita Service Center

THIS PROPOSAL AND PROPOSAL TERMS AND CONDITIONS (these "terms") are by and between the person or entity listed as the Owner/Operator on this Agreement (hereinafter, the "Customer") and Learjet, Inc., or its subsidiaries, as applicable (hereinafter referred to as "BAS").

CLICK HERE for Bombardier's Proposal and Work Order Terms & Conditions (or visit www.cic.bombardier.com for more information).

Schedule:

- The aircraft is tentatively scheduled to arrive at our **BAS - Wichita** Service Center on **June 11, 2018**. The downtime of **21** consecutive day(s) is an estimate only and will be confirmed upon Proposal signature. The estimated departure date is **July 1, 2018**.
- Our planning process starts when the proposal is signed. An early signature will maximize our ability to secure a position within the time frame you desire and order required parts. Parts availability and lead times may impact our ability to perform all the work outlined in this proposal. Hangar maintenance positions are assigned on a first come, first served basis.

Added Value Received at Bombardier Service Centers:

- Our OEM network specializes in only Bombardier products. Our facilities, training, and expertise are unmatched in the industry. We know your aircraft better than anyone!
- Each of our centers is stocked with significant parts inventory and specialized tooling for your convenience.
- BAS sells Bombardier parts at list price, and there are no handling fees for components replaced under warranty or Smart Parts.
- The BAS network provides labor coverage for parts warranty. If a part that was previously installed at a BAS facility fails during its warranty period, BAS will cover the labor to replace the part at any BAS network facility.
- Standard shipping is at no charge for Bombardier factory-installed replacement airframe parts.
- Bombardier engineering support enhances our technical team when repairs are required.
- Program experts, located at each center, work on your behalf to efficiently administer warranty, Smart Parts, and vendor programs.
- Mobile trucks and dedicated Customer Response Teams are ready to support your needs when you are away from our centers.

Workscope Details *[cont'd]*:

- **Navigation - (FANS) 1/A+ - Installation of the avionics update for Future Air Navigation System per Rockwell Collins STC ST04027CH (604)** *[cont'd]*
  - If an Inmarsat Satcom is existing in the aircraft, a Push Button Annunciator (PBA) is being installed with this STC that will enable the capability to shut down this system during a FANS portion of a flight to alleviate any possibility of the Inmarsat blocking an Iridium FANS message. During this segment of flight the Inmarsat Satcom should not be used. Interface of this PBA disable switch is quoted separately if required.
  - At this time, this STC is approved for US, Transport Canada, and EASA registered aircraft. Additional approval may be required for other foreign registered aircraft at additional cost and lead/down time.
  - With the purchase of the Rockwell Collins 604 FANS 1/A+ STC, Rockwell Collins will provide a one year subscription to the ARINC Direct FANS Gold Plan which includes:
    - FANS 1/A+ Letter of Authorization (LOA) assistance.
    - Flight Planning and Operations Services.
    - iPad application
    - Flight Department training

    Optional additional services will also be available from ARINC Direct at additional cost.
  - Engineering and documentation will be provided to support this new installation in accordance with a log book entry for STC ST04027CH or SA17-58 (Transport Canada)

- **Rockwell Collins Data Base Unit (DBU-5010E) with sliding access door for FANS SB/STC requirement for aircraft with DBU-5000 existing (604)** — **Guaranteed $10,781**
  - Price includes:
    - Rockwell Collins DBU-5010E with a sliding access door
    - Trade in credit for the existing DBU-5000
    - STC Certification
  - Price excludes:
    - USB type memory device required for use with the DBU-5000/5010E
    - Deviations to the STC if required for this installations
  - The following major component will be installed:
    - DBU-5010E with sliding access door
  - The installation will consist of the following interface:
    - The existing DBU-5000 or PCD-3000 will be removed and returned to Rockwell Collins for a special trade-in program credit and a new DBU-5010E will be installed in the same location using the same wiring and connectors. No additional interface is provided with this quote.
  - The following functionality will be provided:
    - The new DBU-5010E utilizes a USB type memory (flash drive) to transfer database uploads from the Rockwell Collins FMS website for installation in the aircraft. This method removes the necessity of loading multiple discs and reduces the time required to load the FMS databases. The DBU-5010E is the latest enhanced version of the Data Base Unit which is compatible with both the Proline 4 system with 3.0 or later software and will support future growth potential.
    - The DBU-5010E is also compatible with the new Rockwell Collins IMS-3500 Ascend system.
  - Engineering and certification documentation will be provided to support the new installation in accordance with Rockwell Collins STC ST01431WI-D or TCCA STC SA08-63 or EASA.IM.A.S.02703 (EASA)

- **Navigation - Installation of Automatic Dependent Surveillance - Broadcast (ADS-B) v2 (DO-260B) approval per STC ST00841DE (604)** — **Guaranteed $33,542**
  - *Price reflects price adjustment for correctly installed transponder & IOC.*
  - Price includes:
    - Vendor update of the TRD-94D Transponder (2 ea.)
    - Vendor update of the IOC-4000 (4 ea.)
  - Price excludes:
    - Prerequisites
    - Additional update or repair to any IOC or Transponder required to return the component to service after this upgrade.
    - Vendor expedite fees if available
    - Modification to remove wiring if SB 604-34-058 has been previously complied with

Workscope Details *[cont'd]*:

- **Navigation - Installation of Automatic Dependent Surveillance - Broadcast (ADS-B) v2 (DO-260B) approval per STC ST00841DE (604)** *[cont'd]*
  - Expedite fees may be available on a case by case basis from the vendor for the update of the Transponders and IOC units. Pricing for expedite is subject to change with no notice from the vendor.
  - The following SBs are prerequisites and must be previously complied with or performed concurrently:
    - SB 604-34-040 R1 (Modification - ATC - transponder System - Introduction of Mode S Enhanced Surveillance for aircraft with Precision Plus)
    - SB 604-34-057 R3 (Modification - Global Positioning System (GPS) - Installation of Wide Area Augmentation System (WAAS) capable GPS system) or equivalent Rockwell Collins STC ST01433WI-D
  - The WAAS GPS receivers must be P/N 822-2189-004 or later. If the existing GPS are P/N 822-2189-002 and additional update to these receivers will be required.
  - Quote is for US, EASA, and Transport Canada registered aircraft. Additional certification may be required for other foreign registered aircraft at additional cost and down time.
  - Engineering and documentation will be provided to support this installation in accordance with a log book entry, STC ST00841DE (US), SA17-34(TCCA), 10061270 (EASA)

Additional Items Details:

- **SB 604-34-058 R2 - Navigation - Air Traffic Control Transponder System (ATC) - Incorporation of ATC Transponder with Automatic Dependent Surveillance Broadcast (ADS-B) Out capability** — **See Note(s)**
  - SB 604-34-058 is obsolete as this SB only provides for ADS-B version 1 (DO-260A) and does not meet the 2020 mandate. STC ST00841DE does meet the 2020 mandate (DO-260B) and should be incorporated

- **Required interior access for FANS installation.** — **Estimate $8,366**

(2018) AIRCRAFT WORK PROPOSAL AND AGREEMENT

EMBRAER

QUOTE#: SB550-34-0002	DATE: 08/31/2018
WORK PACKAGE#: T.B.D.	
DATE OPENED: 8/31/2018	DATE CLOSED

1A.☐ EEJS MRO CENTER (ARIZONA)
5643 S. Avery Circle, Mesa, AZ 85212
FAA Approved Repair Station No. 1MB2176B

2. CUSTOMER (hereafter Customer)
SERVICIOS AEREOS ACROSS, S.A. de C.V.
Juan Salvador Agraz 65 Piso 12 Col. Santa Fé de Cuajimalpa , Cuajimalpa de Morelos
05348 CIUDAD DE MEXICO
Attn: Alberto Gayosso

3. AIRCRAFT:

Type / Model:	**Legacy 500**
Serial Number:	**550000044**
Registration Number:	**XA-COS**

4. Work Scope and Price: (Estimated labor only unless noted below)

SB550-34-0002: ADS B OUT DO-260B Upgrade from DO-260A

Engineering	**$ 30,000.00**
Parts	**$ 15,000.00**
Labor	**$ 1,330.00**
TOTAL – 550 00040 & 550 00074 (SB550-34-0009)	**$ 46,330.00**
Less Embraer Concession	**< $ 46,330.00 >**
TOTAL – Free of Charge	**Warranty**

CUSTOMER shall supply Top Kit for ADS B. EEJS shall provide Transponder

5. TOTAL WORK SCOPE PRICE: **$ 0.00 – No cost to customer**

6. PAYMENTS:

a. Initial payment due: **N/A**
b. Additional payment due: **N/A**
c. Balance due on delivery of Aircraft*: **NET 30**
* Outside vendor charges may be billed at a later date.

7. Scheduled input date: October 8, 2018

8. Scheduled delivery date: October 11, 2018

9. PROPOSAL ACCEPTANCE PROCEDURES:

THE PRICES CONTAINED IN THIS AIRCRAFT WORK PROPOSAL (HEREINAFTER PROPOSAL) SHALL REMAIN FIRM FOR A PERIOD OF THIRTY (30) DAYS FROM THE DATE HEREOF.
IN ORDER TO ACCEPT THIS PROPOSAL, CUSTOMER SHALL SIGN THIS DOCUMENT IN THE SPACE PROVIDED BELOW AND RETURN IT TO EEJS WITHIN SUCH THIRTY (30) DAY PERIOD. UPON EXECUTION BY EEJS, THIS PROPOSAL SHALL BE DEEMED A BINDING CONTRACT. UNTIL ACTUAL RECEIPT BY EEJS OF A SIGNED PROPOSAL FROM THE CUSTOMER, EEJS MAY WITHDRAW OR MODIFY THE PROPOSAL. THE EXHIBITS ATTACHED HERETO ARE EXPRESSLY MADE PART OF THIS AIRCRAFT WORK PROPOSAL AND AGREEMENT. EEJS'S ACCEPTANCE IS CONDITIONED UPON CUSTOMER'S AGREEMENT TO ALL OF THE TERMS AND CONDITIONS OF THIS WORK PROPOSAL AND AGREEMENT, INCLUDING THE ATTACHED TERMS AND CONDITIONS, EEJS MRO LIMITED SERVICE WARRANTY AND ALL EXHIBITS ATTACHED HERETO (COLLECTIVELY REFERRED TO AS "AGREEMENT").
TERMS AND CONDITIONS CONTAINED HEREIN MAY NOT BE AMENDED WITHOUT THE WRITTEN CONSENT OF EEJS.

☐ **EEJS MRO CENTER (ARIZONA)** ☐ Customer	**ACCEPTED AND AGREED TO:**
By ________________	By ________________
Title ________________	Title ________________
Date ________________	Date ________________

➢ **Proposal Summary**

2.0 AVIONICS/ELECTRICAL

(Pricing for Labor and materials unless specified) ***(Line Item Images for Reference Only)*** **Note:** See Terms and Conditions: Exceptions / Assumptions

Description of Service:

2.1 Garmin ADS-B "In & Out" Compliance……………………………………………………………….........**$63,965.00**

2.1.1 Remove the two (2) each existing Collins TDR-90 units and associated CTL-9X control from the aircraft.

2.1.2 Provide and install one (1) each new GTX-345R remote mount "Mode S / ADSB compliant" internal WAAS GPS capable transponder (with Gables Control unlock enablement).

The new Garmin GTX-345R "Mode S / ADSB compliant" capable transponder unit installation with WAAS GPS input satisfies the pending ADS-B "Out" Mandate and provides for ADS-B "In" (***compatible PED displayed***) and BlueTooth connection capabilities

***Pictures are for reference only. Actual unit may vary.**

2.1.3 Provide and install one (1) each new Garmin GTX-335R remote mount "Mode S / ADSB compliant" internal WAAS GPS capable transponder (with Gables Control unlock enablement).

2.1.4 Provide and install one (1) each new Gables G7534-100X dual transponder control head in the CTL-92 vacated location.

***Pictures are for reference only. Actual unit may vary**

aeropersonal®

4138

Toluca, Edo. de México a 24 de Marzo de 2017

SECRETARÍA DE COMUNICACIONES Y TRANSPORTES
DIRECCIÓN GENERAL DE AERONÁUTICA CIVIL
DIRECCIÓN DE AVIACIÓN
BLVD. ADOLFO LÓPEZ MATEOS No. 1990
COL. LOS ALPES TLACOPAC
DELEG. ALVARO OBREGON
01016 MÉXICO, D. F.

REF.- DM240317

AT'N: ING. GUILLERMO A. MAGAÑA HERNÁNDEZ
DIRECTOR DE AVIACIÓN

ASUNTO: Solicitud para trabajos en el extranjero de la aeronave XA-HIT

Por este medio me permito solicitar a esa Dirección bajo su digno cargo, la autorización de reparación en el extranjero para la aeronave marca Cessna, modelo 680, número de serie 0014, matrícula XA-HIT, por la actualización del cumplimiento de los nuevos requerimientos mandatorios **ADSB-out** DO-260B para el año 2020, actualización del software EPIC carga fase 5.3 por el boletín SB 680-34-33 R1, actualización de software CAS 67A **TCAS II 7.1** y el cumplimiento del Documento de Inspección 12. Lo cual se propone efectuar en las instalaciones del taller aeronáutico del fabricante Cessna Aircraft Company, ubicado en 2121 South Hoover Road, Wichita, Kansas, 67209, United States, con número de convalidación DGAC CO-026/11 y permiso FAA #CNQR918C.

No omito comunicarle que la aeronave tiene un contrato de mantenimiento celebrado con este taller aeronáutico, sin embargo es necesario efectuar los mencionados trabajos en el taller del fabricante. El Tiempo estimado de la duración de los trabajos es de 15 días hábiles, con fecha de inicio 15 de Mayo de 2017.

Como complemento a nuestra solicitud me permito anexar la siguiente documentación:

- Forma DGAC IA-50/94A debidamente requisitada.
- Copia de la última hoja de bitácora de la aeronave.
- Cotización del taller aeronáutico.
- Copia de SB 680-34-33 R1

Agradeciendo de antemano la atención a la presente, le reitero mi consideración distinguida.

ATENTAMENTE

ING. JORGE FERNANDO DEL CAMPO ILLINGWORTH
GERENTE DE INGENIERIA, PROGRAMACION,
CAPACITACION Y APROVISIONAMIENTO

Ventanilla Única de Servicios D.G.A.C.
ENTRADA
27 MAR 2017
4100068
SCT

Aero Personal

BOULEVARD AVIACIÓN GENERAL LOTE 31, AEROPUERTO INTERNACIONAL DE TOLUCA, C.P. 50200 TOLUCA, EDO. DE MÉXICO
TEL. (01722) 548-0300 FAX: (01722) 548-0317

SECRETARIA DE COMUNICACIONES Y TRANSPORTES

FORMA IA-50/94-A

APÉNDICE "A" NORMATIVO
SOLICITUD PARA EFECTUAR MANTENIMIENTO A AERONAVES Y SUS COMPONENTES EN EL EXTRANJERO

1.- DATOS DEL SOLICITANTE.

NOMBRE: **AEROPERSONAL, S.A. DE C.V.**

DIRECCIÓN: **BOULEVARD DE LA AVIACION GENERAL LT 31, APTO. INT. DE TOLUCA, TOLUCA, EDO. DE MEXICO, C.P. 50200**

TELÉFONO: **(01 722) 548 03 00** FAX: **(01 722) 548 03 17**

2.- DATOS DE LA AERONAVE.

PROPIETARIO O POSEEDOR: **AERO TRANSPORTES CORPORATIVOS, S.A. DE C.V.**

MARCA: **CESSNA** MATRICULA: **XA-HIT**

MODELO: **680** T.T. **2085:54 HRS.**

No. DE SERIE: **680 - 0014** T.U.R.M. **N/A**

BASE DE OPERACIONES: **AEROPUERTO INTERNACIONAL DE TOLUCA, ESTADO DE MEXICO.**

3.- DATOS DEL COMPONENTE A REPARAR:

NOMBRE	PLANEADOR	MOTOR 1	MOTOR 2	APU
MARCA:	CESSNA	PRATT & WHITNEY	PRATT & WHITNEY	HONEYWELL
MODELO:	680	PW306C	PW306C	RE 100CS
No(S) DE SERIE	0014	PCE-CG0025	PCE-CG0026	P-114
T.T.	2089:04 HRS.	2038:54 HRS.	2038:54 HRS.	1238.0 HRS.
T.U.R.M	N/A	N/A	N/A	N/A

4.- DATOS DEL TALLER AERONÁUTICO EXTRANJERO:

NOMBRE: **CESSNA AIRCRAFT COMPANY.**

DIRECCIÓN: **2121 SOUTH HOOVER ROAD, WICHITA, KANSAS, 67209, UNITED STATES.**

NO. DE PERMISO EMITIDO POR LA AUTORIDAD AERONÁUTICA EXTRANJERA: **FAA # CNQR918C**

5.- DESCRIPCIÓN TÉCNICA DETALLADA DE LOS TRABAJOS QUE SE PRETENDEN EFECTUAR::

POR LA ACTUALIZACIÓN DEL CUMPLIMIENTO DE LOS NUEVOS REQUERIMIENTOS MANDATORIOS ADSB-OUT DO-260B PARA EL AÑO 2020, ACTUALIZACIÓN DEL SOFTWARE EPIC CARGA PHASE 5.3 POR EL BOLETÍN SB 680-34-33 R1, ACTUALIZACION DE SOFTWARE CAS 67A TCAS II 7.1 Y EL CUMPLIMIENTO DEL DOCUMENTO DE INSPECCIÓN 12.

6.- MOTIVO DE LA SOLICITUD: **EN ENTENDIDO DE QUE NO EXISTEN TALLERES AERONAUTICOS AUTORIZADOS POR LA AUTORIDAD AERONAUTICA Y EL FABRICANTE EN TERRITORIO NACIONAL PARA EFECTUAR LA ACTUALIZACION DE LOS EQUIPO DE AVIONICA PARA EL CUMPLIMIENTO DE LOS NUEVOS REQUERIMIENTOS MANDATORIOS**

7.- FECHA ESTIMADA DE SALIDA: **15 DE MAYO DE 2017**

8.- TIEMPO ESTIMADO DE LA DURACIÓN DE LOS SERVICIOS: **15 DÍAS HABILES**

9.- NOMBRE Y FIRMA DEL RESPONSABLE O SOLICITANTE: **ING. JORGE FERNANDO DEL CAMPO ILLINGWORTH**

10.-LUGAR Y FECHA: **TOLUCA, EDO, DE MÉXICO, A 24 DE MARZO DE 2017**

- TT: TIEMPO TOTAL DE LA AERONAVE Y/O COMPONENTE.ESTA FORMA PODRÁ OBTENERSE CON LA AUTORIDAD AERONÁUTICA MÁS CERCANA.
- TURM: TIEMPO DESDE ULTIMA REVISIÓN MAYOR.

Dear Jose,

Thank you for considering Textron Aviation to maintain your aircraft. As a part of Textron Aviation we at Cessna ServiceDirect, LLC, referred to as the "Service Center", have a vested interest in making sure you are delighted with your Textron Aviation Service Center experience. As part of our commitment to exceptional service we submit for your review the following Service Proposal. If any of the services or products described below is not as requested, please contact me immediately for a revision.

PROPOSAL DETAILS

Upgrade Existing Honeywell Transponders to ADS-B out (Standard Turn Time) **$72,435.00**

- Upgrade meets ADSB-out DO-260B 2020 Mandate Requirements
- Continuously broadcast aircraft position, heading, and velocity
- Ground base, en-route, and terminal surveillance
- Non-radar area surveillance, and surface movement surveillance enhancements

Epic Software load Phase 5.3 will be loaded along with the new transponder transmission software.

The installation will be accomplished via Cessna service bulletin, SB 680-34-33.

Note: The above pricing assumes WAAS has been previously incorporated

This price is based on a two phases approach.

Phase 1: Mobile Service Unit (MSU) visit scheduled two weeks in advance. MSU team will remove old PN Transponders and install Rental / Loaner Old PN Transponders. Removed transponders will be shipped out for modifications. You are now able to operate the AC as you have been. A rental fee will be charged at a rate of $4,660.00 for the duration of the modification. Rental unit must be returned to TAPD within two weeks of notification of modified units availability or additional charges will be applied. The standard MSU relocation fee and travel charges apply and will be billed on a time and material basis.

Phase 2: At the time of removal a schedule is set for a Textron Aviation shop visit to have the removed, now modified, transponders installed along with the required software updates. Loaners removed and shipped back to TAPD

If during modification of the core transponders, repairs are required you will be notified of the additional cost at the time of discovery.

****Aircraft must have WAAS SB680-34-27 prior to installation of this SB.

CAS 67A TCAS II Software / Upgrade to 7.1 **$27,695.00**

Proposal Number:
1701276800014
Serial Number: 680-0014

Gary T. Genge
Area Sales Manager
Phone: 316-761-4607
Fax: 316-206-8791

Flight Manual Revision / Supplement Required:	None
Publications Data:	Data concerning this service change will be published in a future revision of the affected manual(s). This booklet will provide technical data until the revision(s) is published.
Effectivity	This service change is applicable to aircraft serial numbers 4002 – subsequent.
Effect on Spares:	Transponder module, PN 7517402-970, should be used for spares following incorporation of this modification.
Special Equipment / Tools Required:	Aircraft PC Laptop with Remote Terminal Tool version 26.0 or later. Refer to Gulfstream PlaneView Maintenance Applications disk version 8.4, or later PN 1159LAP59000.
Skill Type Required:	Knowledge of the navigation, indicating / recording systems; electrical standard practices; and software loading procedures will be required for this installation.

Price:	Prices are subject to change without notice.	
Installed Price:	Installation labor is included in kit cost.**	
Kit Price only:	Domestic:	$ 75,000.00
	International:	$ 76,500.00

**NOTE:	This ASC is managed by Product Support Program Management (PSPM). Incorporation MUST be coordinated through PSPM via email at pspm@gulfstream.com or through Gulfstream Aircraft Scheduling at 800-810-GULF (4853) or 912-965-4178. If not scheduled, aircraft downtime could increase significantly. This ASC may only be accomplished at a Gulfstream facility or a facility that has been approved by Gulfstream in writing to perform this specific modification.

4. Certification

The following table provides:

- STC numbers of certified packages depending on certification authorities (FAA, EASA, ANAC and TCCA)
- Estimated dates of entry into service of Falcon Pro Line 21 packages which are currently in development

Package	Certification FAA	EASA	ANAC	TCCA
SBAS GPS (WAAS & EGNOS)	X RC* STC ST01433WI-D	X STC 10016518	X STC 2009S04-01	X STC SA09-17
LCD Displays w/ FMS 6.1 (LPV) *F50EX*	X STC ST11041SC	X STC 10045378	Not applied	X STC ST11041SC
LCD Displays w/ FMS 6.1 (LPV) *F2000/2000EX*	X STC ST11047SC	X STC 10048395	X STC 2015S11-05	X STC ST11047SC
ADS-B Out (DO 260A) *F50EX*	X STC ST02963NY-D	X STC 10041723	Not applied	X STC ST02963NY-D
ADS-B Out (DO 260B) *F50EX*	X STC ST02963NY-D	Expected 2H16	Expected 2H16	Expected 2H16
ADS-B Out (DO 260A) *F2000/2000EX*	STC ST02962NY-D	STC 10041722 for PL4 only	2012S09-03 for PL4 only	ST02962NY for PL4 only
ADS-B Out (DO 260B) *F2000/2000EX*	STC ST02962NY-D	Expected 2H16 for PL21 only	2012S09-03 for PL21 only	ST02962NY for PL21 only
Dual Jeppesen Charts *F50EX*	X STC ST11041SC	X STC 10045378	Not applied	X STC ST11041SC
Dual Jeppesen Charts *F2000/2000EX*	X STC ST11047SC	X STC 10048395	X STC 2015S11-05	X STC ST11047SC
XM graphical weather *F50EX*	X STC ST11041SC	X STC 10045378	Not applied	X STC ST11041SC
XM graphical weather *F2000/2000EX*	X STC ST11047SC	X STC 10048395	X STC 2015S11-05	X STC ST11047SC
FANS 1/A+ *F50EX*	X STC ST04044CH	Expected 1H17	Expected 1H17	Expected 1H17
FANS 1/A+ *F2000/2000EX*	X STC ST03586NY	Expected 1H17	Expected 1H17	Expected 1H17
SVS F50EX	X RC* STC ST11165SC	Not applied	Not applied	Not applied
SVS F2000/2000EX	X RC* STC ST11162SC	Not applied	Not applied	Not applied

*RC : Rockwell Collins

FORMA IA-50/94-A

APÉNDICE "A" NORMATIVO
SOLICITUD PARA EFECTUAR MANTENIMIENTO A AERONAVES Y SUS COMPONENTES EN EL EXTRANJERO

1.- DATOS DEL SOLICITANTE.

NOMBRE: **TRANSPORTES AEREOS MEXIQUENSES, S.A. DE C.V.**

DIRECCIÓN: **BOULEVARD DE LA AVIACION GENERAL LT 31, APTO. INT. DE TOLUCA, TOLUCA, EDO. DE MEXICO, C.P. 50200**

TELÉFONO: **(01 722) 548 03 00** FAX: **(01 722) 548 03 17**

2.- DATOS DE LA AERONAVE.

PROPIETARIO O POSEEDOR: **AERO PERSONAL, S.A. DE C.V.**

MARCA: **DASSAULT** MATRICULA: **XA–CDT**

MODELO: **F2000EX** T.T. **3314:17 HRS.**

No. DE SERIE: **020** T.U.R.M. **N/A**

BASE DE OPERACIONES: **AEROPUERTO INTERNACIONAL DE TOLUCA, ESTADO DE MEXICO.**

3.- DATOS DEL COMPONENTE A REPARAR:

NOMBRE	PLANEADOR	MOTOR 1	MOTOR 2	APU
MARCA:	DASSAULT	P&W	P&W	HONEYWELL
MODELO:	2000EX	PW308C	PW308C	GTCP36-150 (F)
No(S) DE SERIE	020	PCE-CF0050	PCE-CF0061	P-359
T.T.	3314:17 HRS.	3223:51 HRS.	3223:51 HRS.	2227.0 HRS.
T.U.R.M	N/A	N/A	N/A	N/A

4.- DATOS DEL TALLER AERONÁUTICO EXTRANJERO:

NOMBRE: **DASSAULT FALCON JET SERVICE CENTER.**

DIRECCIÓN: **3801 EAST 10TH STREET, LITTLE ROCK, ARKANSAS, 72202, UNITED STATES,**

NO. DE PERMISO EMITIDO POR LA AUTORIDAD AERONÁUTICA **DGAC 118/15 Y FAA # D8QR774X**

5.- DESCRIPCIÓN TÉCNICA DETALLADA DE LOS TRABAJOS QUE SE PRETENDEN EFECTUAR::
EVALUACION DE DAÑOS Y REPARACION DE LA AERONAVE, ASI COMO ACTUALIZACIÓN DE EQUIPOS TRANSPONDER PARA CUMPLIR CON LOS NUEVOS ORDENAMIENTOS ADS-B OUT (DO-260B).

6.- MOTIVO DE LA SOLICITUD: **LA AERONAVE SE ENCUENTRA FUERA DE LA BASE DE OPERACIONES, SUFRIO UN EVENTO NO PROGRAMADO QUE REQUIERE ATENCION INMEDIATA Y NO EXISTEN TALLERES AERONAUTICOS EN TERRITORIO NACIONAL QUE PUEDAN REALIZAR ESTOS TRABAJOS.**

7.- FECHA ESTIMADA DE SALIDA: **LA AERONAVE SE ENCUENTRA ACTUALMENTE FUERA DE TERRITORIO NACIONAL**

8.- TIEMPO ESTIMADO DE LA DURACIÓN DE LOS SERVICIOS: **NO ESTIMADO (EVALUACION Y REPARACION). 12 DIAS CALENDARIO (ACTUALIZACION).**

9.- NOMBRE Y FIRMA DEL RESPONSABLE O SOLICITANTE: **ING. JOSE DE JESUS MORALES ORTEGA**

10.-LUGAR Y FECHA: **TOLUCA, EDO. DE MÉXICO, A 4 DE ABRIL DE 2018**

- TT: TIEMPO TOTAL DE LA AERONAVE Y/O COMPONENTE.ESTA FORMA PODRÁ OBTENERSE CON LA AUTORIDAD AERONÁUTICA MÁS CERCANA.
- TURM: TIEMPO DESDE ULTIMA REVISIÓN MAYOR.

DASSAULT
AIRCRAFT SERVICES

Aircraft Work Proposal And Agreement

March 06, 2018
PROPOSAL LRQ17-00316 Rev: 2

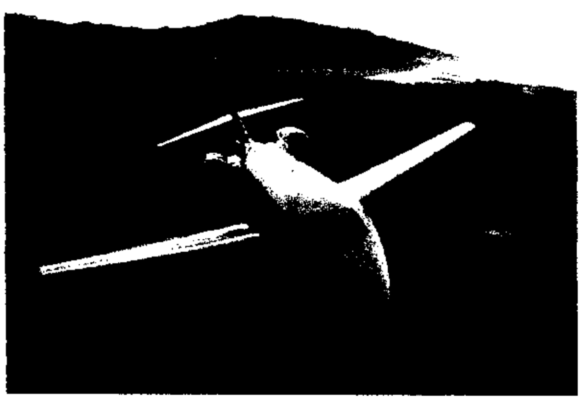
TRANSPORTES AEREOS MEXIQUENSES, S.A. DE C.V.
S.A. DE C.V.
CAMPOS ELISEOS NO.400 PISO 10D
COL.LOMAS DE CHAPULTEPEC
MEXICO DF, 11000
Mexico

Dassault F2000EX #020 XA-CDT
ADS-B Out DO-260B

Dassault Falcon Jet Corp (Service Center)
FAA Approved Repair Station No. D8QR774X
3801 E. 10th Street
Little Rock, AR 72203
Phone: 302 985-3885 Fax: 302 322-7356

Fabiola Ribeiro
International Marketing Manager

Fabiola.Ribeiro@FalconJet.com
Cell # 302.757-0667



2.1 - F2000-F2000EX ADS B-OUT UPGRADE FROM DO-260A TO DO-260B

EFFECTIVITY: F2000 S/N 001-231 AND F2000EX S/N 001-005, 007-027 WITH ADS-B OUT DO-260A PREVIOUSLY INSTALLED.

ADS-B OUT DO260A TO DO260B IS THE NEXT LOGICAL STEP TO ACHIEVE ADS-B OUT COMPLIANCE WITH THE EUROPEAN AND AMERICAN MANDATES.

BEFORE MODIFICATION:
AIRCRAFT IS EQUIPPED WITH ADS-B OUT DO260A. INSTALLED VIA STC #ST02962NY-D.

AFTER MODIFICATION:
ADS-B OUT DO260B IS INSTALLED ON THE AIRCRAFT.

THE FOLLOWING COMPONENTS WILL BE SENT FOR UPGRADE AND INSTALLED AS FOLLOWS:
- 2 EA. TDR-94D, TRANSPONDERS, P/N: 622-9210-501

THE FOLLOWING NEW COMPONENTS WILL BE INSTALLED:
- 2 EA. BA-440 FILTER/ROUTER, P/N: 601-0440-001
- 2 EA. BA-440 CONFIGURATION MODULE ASSY, P/N: DA5AD5B2
- 3 EA. ANNUNCIATORS

ESTIMATED DOWNTIME: 5 ADDITIONAL DAYS IF DONE SIMULTANEOUSLY WITH BASELINE PACKAGE. 7 DAYS IF DONE SEPARATELY.

NOTES:
- TO FACILITATE THIS INSTALLATION ADDITIONAL LABOR FOR THE REMOVAL AND RE-INSTALLATION OF COCKPIT/CABIN FEATURES MAY BE REQUIRED DUE TO UNIQUE VARIATIONS IN CONFIGURATION.
- ANY MODIFICATIONS OF UNITS, WIRING CHANGES, OR DEVIATIONS FROM THE STC REQUIRED TO BRING THE AIRCRAFT INTO CONFORMITY WILL BE PERFORMED AND INVOICED ON A TIME AND MATERIAL (T&M) BASIS.
- THE TRANSPONDERS ARE UPGRADED VIA ROCKWELL COLLINS SB 514.

CERTIFICATION:
- FAA STC (F2000/EX): ST02962NY-D
- BRAZILIAN ANAC STC (F2000 ONLY): 2012S09-03
- TCCA STC (F2000/EX): ST02962NY-D
- EASA STC (F2000/EX): APPROVAL PENDING

NOTE: IT WILL BE THE RESPONSIBILITY OF THE CUSTOMER TO OBTAIN THE DGAC (MEXICO) APPROVAL FOR THE INSTALLATION.

Total 77,600.00

2.2 - EXPEDITE FEE FOR TRANSPONDER UPGRADES

NOTE: AVERAGE TURN AROUND TIMES AT ROCKWELL COLLINS FOR UPGRADES ARE 14-20 BUSINESS DAYS.

Total 5,868.00

2.3 - INTERIOR ACCESS REQUIRED FOR ADS-B OUT 260B UPGRADE

Total 6,900.00

SECRETARÍA DE COMUNICACIONES Y TRANSPORTES

DIRECCIÓN GENERAL DE AERONÁUTICA CIVIL

ANÁLISIS DE IMPACTO REGULATORIO

PROY-NOM-091/2-SCT3-2018

APÉNDICE B.- TRANSFORMING AIR TRAFFIC WITHIN THE US NATIONAL AIR SPACE SYSTEM

Project Management Institute

CASE STUDY

Series on Program Management Success in Government

Transforming Air Traffic within the US National Airspace System

November 2014

KEY FINDINGS

The Transformation of the U.S. Air Traffic Control System

The Next Generation Air Transportation System – or NextGen – and its component programs are designed to overhaul air traffic control as we know it and transform the National Airspace System (NAS).[1] Of the four components of NextGen, ADS-B[2] (Automatic Dependent Surveillance-Broadcast) is the "cornerstone" that will transform the United States' air traffic control system from a ground-based surveillance system, which has been in place for the last six decades, to a satellite-based surveillance system using GPS technology. This system will reduce traffic delays, save time and fuel, permit controllers to monitor and manage aircraft with more efficiency and increase capacity. For this report, capacity refers to the number of aircraft managed within the system that keeps pace with the increased demand for flights by users.

> *"ADS-B is the enabling technology for NextGen. It's the cornerstone, the first out of the box."*

The NextGen program is managed within the U.S. Department of Transportation, Federal Aviation Administration (FAA), Air Traffic Organization (ATO). Within this operational component exists a permanent program management organization (henceforth referred to as the Program Office) responsible for acquisitions, services, and products. The Program Office buys, develops and sustains systems and develops standards for avionics. In the case of ADS-B, the Program Office was tasked with the introduction of a new layer of surveillance into the NAS and figuring out a plan to execute it. It was granted a US$1.7 billion program baseline for 2007-2014.

ADS-B was awarded official program status in 2007, to undertake activities to deploy the new capability, but also to publish a federal mandate requiring aircraft operating in specified airspace to be equipped with ADS-B by 2020. This system improves air traffic control by updating air traffic controllers of the whereabouts of an airplane once every second, as opposed to as much as every 12 seconds under the old system. One interviewee suggests the following analogy: "Imagine driving home tonight in your car and you only get to open your eyes every 12 seconds." ADS-B not only allows for more frequent updates, but more data and more accurate data, "allowing controllers to safely meet increased traffic demands and enable more efficient flight operations."

Success despite size and scope. The largest public works project in U.S. aviation history, the ADS-B program is one of unprecedented magnitude (budget, scope and duration) for both the FAA and its numerous non-government partners (airlines, pilots, aircraft manufacturers, etc.). With a budget that has surpassed US$1 billion, and a timeline of over 13 years from program initiation to the mandate compliance date, it could have encountered myriad hiccups, even failures, as it progressed through its various lifecycles.

> *"Why should a ground-based system ask a plane who it is? Why can't the plane just tell me? And I'll listen on the ground. And that's what ADS-B does."*

[1] The airspace structure is a complex environment that requires the use of highly technical air traffic control (ATC) procedures. The Federal Aviation Act of 1958 established the FAA and made it responsible for the control and use of navigable airspace within the United States. The FAA created the National Airspace System (NAS) to protect persons and property on the ground, and to establish a safe and efficient airspace environment for civil, commercial, and military aviation. The NAS is made up of a network of air navigation facilities, ATC facilities, airports, technology, and appropriate rules and regulations that are needed to operate the system. Source: www.faa.gov.

[2] Automatic Dependent Surveillance-Broadcast, more commonly referred to as ADS-B.

Instead, it has managed to persevere through both the development and implementation phases to enter the operational phase with the future looking extremely bright. More specifically, ADS-B has accomplished the following:[3]

- Initiated efficiencies to meet baseline cost and schedule expectations with project expenditures coming in lower than planned. Earned Value Management (EVM) shows the program meets baseline cost and schedule expectations, and project expenditures are lower than the current plan, also due to efficiencies. Furthermore, these results are shown consistently across EVM, the Simplified Program Information Reporting and Evaluation (SPIRE) tool[4], the Federal IT Dashboard, and the Exhibit 300 Program Baseline.
- Awarded additional funding or "plus-ups" from U.S. Congress two years in a row and immunized from budget cuts that affected other NextGen programs. Congress was impressed with the solid performance of the program in its first two years – meeting milestones, developing traction and engaging industry – and felt it was critical to investigate future applications and continue to stimulate equipage.[5]
- Achieved all benefits and service objectives at its various target sites, which resulted in increased safety (lower accident rates) in remote regions, fuel savings, capacity, distance savings and decreased search-and-rescue and flight-delay times, among other positive outcomes.
- Accelerated equipage of ADS-B technology through incentivizing early adopters which would not have happened had the program not offered to offset airline costs around certification, and non-recurring costs around engineering and testing.
- Achieved 15 of 16 technical performance goals, including interval and latency requirements.

Key building blocks to success. The numerous industry accolades and considerable press attention make the ADS-B program worthy of additional attention.

With that goal in mind, this study examines the key "building blocks" of program success, including but not limited to the following:

- Strong leadership and management skills. These were essential to meet the aggressive schedule and other goals set by executives.
- A history of project/program management practices. These were in place long before the ADS-B contract was awarded in 2007, and the belief in the value of these practices grew stronger and spread more widely across the FAA as each milestone was achieved.
- Effective and transparent communication. Utilized both internally and externally with industry and other stakeholders, effective and transparent communication kept everyone highly engaged and motivated, and feeling part of the same winning team.
- Proven project/program management processes and metrics, such as EVM, rolling-wave planning, post-implementation review (PIR) and risk management were relied upon as needed.

> The program sheds light on the discipline of project and program management that has yet to take root with equal fervor across other federal agencies.

[3] "Surveillance and Broadcast Services (SBS) Phase 1 Post-Implementation Review (PIR) Report," March 7, 2013.
[4] The FAA uses an acquisition tracking database, known as the Simplified Program Information Reporting and Evaluation (SPIRE) tool to track and report the progress of all approved acquisitions toward schedule and cost performance targets. GAO-10-629, July 2010.
[5] Equipage refers to the process of equipping aircraft with "communications, surveillance, navigation, and other NextGen avionics equipment, such as ADS-B, either in the form of an equipment or software upgrade depending on the age and type of the aircraft.

- Deliberate and sometimes unorthodox strategies around the use of the business case. The program opted for a service-provider approach, and engagement of stakeholders led to outcomes that otherwise may not have been achieved.

The road to success has been paved with many challenges. The program struggles with external challenges, such as achieving harmonization of requirements across North America and the European Union; aircraft manufacturers who worry about impending budget cuts, and losing momentum for future projects as the program begins to "twilight," were just a few of the challenges. The size and scope of ADS-B means coordination and integration of EVM across its many programs and projects has also been difficult.

Best Practices and Lessons Learned are equally plentiful. Notably, some of the challenges, once overcome, also managed to become best practices. These practices included setting program milestones on an aggressive schedule, integrating multiple performance measures and, in general, relying more on standardized processes. Interviewees also point to communication that encouraged openness and honesty and highly collaborative stakeholder relationships. As a result, problems were identified and solved in a more timely fashion. Other federal government agencies would benefit from instituting these practices and lessons learned in the spirit of growing the project/program management discipline and increasing adoption of organizational project management activities.

DETAILED FINDINGS

Measuring Success

Immune from Budget Cuts

An early indicator of program success was the granting of federal funds or "plus-ups" two years in a row. Because the program has consistently come in on time and within budget, it has never taken a budget cut (outside of universal sequestration). Congress granted additional funding as the program gained traction, hitting necessary targets and engaging and impressing the industry. This allowed the program to investigate future applications that would continue to stimulate equipage of aircraft to meet the 2020 mandate. The program was granted two plus-ups, one in 2008 for US$9.4 million and another in 2009 for US$6.8 million. "These were not huge sums," recalls one interviewee, "but these plus-ups from Congress to investigate other opportunities to leverage this investment would [ultimately provide] additional benefits. ADS-B was a real building block for the future."

Post-Implementation Review

What is more impressive is the consistent way in which the program met the majority of its baseline goals throughout Phase 1, which resulted in the conclusion that the "business case is still valid." The 2013 PIR Report assessed several key areas, each of which is detailed below with specific metrics.

Business Results. According to this report, EVM shows the program meets baseline cost and schedule expectations, and project expenditures are lower than the current plan due to efficiencies. The SPIRE database illustrates this point, indicating a Cost Variance at Completion of US$-16.1M (-0.95%) as of February 2014 (see Exhibit 1). Note: this variance is associated with the two congressional plus-ups referenced above, which added scope outside of the original baseline. Otherwise, the program is estimating completion within the baseline cost.

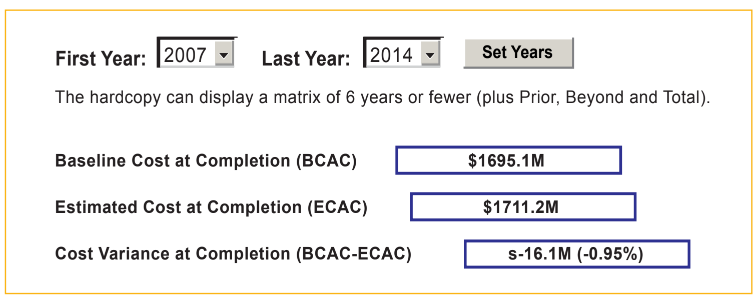


Exhibit 1

Furthermore, these results are shown consistently across EVM, SPIRE, the Federal IT Dashboard and the Exhibit 300 Program Baseline. Although slightly behind with one delay in Service Volume Design Approvals, all variances are within 5% of the program baseline.[6] The Federal IT Dashboard in particular reports the overall status of the ADS-B program rated as "green." Exhibit 2 demonstrates that 11 of 16 key milestones were achieved on time, with September 14, 2014 representing the completion date for the final milestone.

[6] All measures of success detailed in this section can be found in "Surveillance and Broadcast Services (SBS) Phase 1 Post Implementation Review (PIR) Report," March 7, 2013.

APB Milestone	Planned Date	Actual Date
Investment Decision (Segment 1 only)	Jun-06	Jun-06
Investment Decision (Segment 2 only)	Feb-07	Feb-07
Segment 1 Contract Award	Aug-07	Aug-07
Segment 1/2 Investment Decision	Aug-07	Aug-07
Segment 1 Preliminary Design Review (PDR) Completed	Nov-07	Nov-07
Segment 1 Critical Design Review (CDR) Completed	Feb-08	Feb-08
Segment 1 Key Site IOC of Broadcast Services	Aug-08	Aug-08
Segment 1 In-Service Decision (ISD) of Broadcast Services	Nov-08	Nov-08
Final Rule Published in Federal Register	Apr-10	Apr-10
Segment 1 Surveillance and Broadcast Services ISD for ADS-B	Sep-10	Sep-10
IOC ADS-B Capability on CARTS IIIE at New York TRACON	Jun-11	Jul-11
IOC ADS-B Capability on STARS at Houston TRACON	Jun-11	Mar-12
IOC ERAM Release 3 with ADS-B Capability at Houston Center	Sep-11	Apr-12
IOC at Colorado WAM Key Site	Sep-12	Sep-12
Achievement of Critical Services ISAT at all 306 Service Volumes	Dec-13	Apr-14
Complete IOC Surface Advisory Services at all 35 ASDE-X Sites	Sep-14	Open

Exhibit 2

Another indicator of success, the SPIRE dashboard suggests that, as recently as February 2014,[7] the program rates "green" in four of six critical measures during the current deployment phase (financial, schedule, resources and program manager) and "yellow" in the other two (technical and external interest). (See Exhibit 3.)

Program Assessment Program Phase: Deployment **February 2014** Return

Financial	Schedule	Technical	Resources	External Interest	Program Manager
G	G	Y	G	Y	G

Exhibit 3

The OMB (Office of Management and Budget) dashboard[8] variances suggest similar results (note: the OMB cites yellow ratings when variances are plus or minus 10% to 20% of planned values, so both overruns and underruns are flagged). (See Exhibit 4).

[7] FAA, SBS Measurement & Analysis, Performance Control Board, March 27, 2014.
[8] Ibid

Number of Projects: 13

Cost Variance

Schedule Variance

Project Name	Project Life Cycle Costs	Cost Variance	Schedule Variance
Subscription Fees	$590.25 M	Green	Green
Service Volumes ISAT	$183.68 M	Green	Green
Air Traffic Control (ATC) Surface Advisory Services	$138.04 M	Green	Green
Ground Based Interval Management (GIM)	$100.35 M	Green	Green
Automation Upgrades	$91.82 M	Green	Green
Terminal ATC Separation Services	$23.03 M	Green	Green
In Trail Procedures	$13.66 M	Green	Green
Colorado Wide Area Multilateration (WAM Phase 2)	$9.44 M	Yellow	Green
Avionics Updgrades	$8.72 M	Yellow	Green
Traffic Situational Awareness with Alerts (TSAA)	$6.26 M	Green	Green
EN Route ATC Separation Services	$5.94 M	Yellow	Green
3 Nautical Mile Separation	$3.49 M	Yellow	Green
Flight Deck Based Internal Management	$3.36 M	Yellow	Green

Exhibit 4

Performance. In general, the system meets availability, latency and update interval technical performance measures (or TPMs) for all services. There are occasional (<1%) TPMs that do not meet requirements for a given month, but for >99% of the TPMs, the system meets or exceeds requirements. Insiders insist that context is important: it is natural, often expected for systems to go through continuous improvement once fielded, as operators find innovative ways to use the system and issues continue to be debugged.

Benefits and Service Objectives. Benefits and services represent additional areas of success for the program. According to the 2013 PIR Report:

- Gulf of Mexico (or GoMex) has seen efficiency improvements on the following counts:
  - Fuel savings (98 lbs. of fuel saved per equipped Instrument Flight Rules[9] on direct routes)
  - Increased capacity (a four-fold increase in low-altitude airspace usage)
  - Distance savings (a weighted average of 5.62 nautical miles), predictability and effectiveness (on-time crew changes)
  - Safety Instrument Flight Rules operations allow helicopter pilots to avoid "scud running" during bad weather; implementation of real-time weather systems allows for more informed decision-making and fewer flights that have to be aborted due to weather)
- Alaska has shown an increase in safety measures, namely:
  - Lower accident rate (for 2005-2009, the accident rate per million operations was 30.1% lower for ADS-B-equipped aircraft than non-equipped aircraft)
  - Decreased search-and-rescue time (ADS-B data allowed for a flight to be located quickly and to save the life of a pilot)
- Colorado Wide Area Multilateration[10] (WAM) has reduced delays and spacing:
  - Fewer delays (average airborne delay during all weather conditions shows a trend toward fewer delays)
  - Reduced spacing between flights (average spacing between arrivals and departures was reduced at two airports for three one-year periods in a row)

Strategic Impact and Effectiveness. Although the program did not achieve the expected equipage rates, the PIR report stated that "incentives to early adopters were effective in accelerating equipage with rule-compliant avionics." The program lead explains the failure to meet expectations around equipage in this way:

"When the program baseline was set in 2007, the FAA was not aware that the ADS-B avionics standards would need to be modified. Through international coordination, the FAA determined that the standards needed to be changed to provide better quality data. These changes were completed in time to support the rulemaking, but it then took about two years for manufacturers to start developing avionics that met these new standards." In other words, "this was a complex endeavor that was facing many challenges and, no matter how much estimating on cost and schedule (risk adjusted) there will always be some 'unknown unknowns' that can wrinkle the plans." "Fortunately," the program lead continues, "the strong application of program management techniques like risk management, communication management, stakeholder management, requirements management and so forth, afforded this program with the ability to succeed in spite of the complexity."

[9] A rule sets out new or revised requirements and their effective date. It also may remove requirements.
[10] Wide Area Multilateration is another NextGen surveillance system being deployed by the Program Office using the same management techniques as ADS-B.

NextGen: Snapshots of Success

In addition, the FAA "NextGen" website illustrates performance in a series of "snapshots" that further attest to the success of that program.[11] Specific to ADS-B, however, is a story highlighting "new paths" created over the Gulf of Mexico. It traces the path of a JetBlue flight that would have had to reroute due to bad weather, costing both time and money, had it not been equipped with ADS-B technology. It reads:

> *As passengers dozed on a JetBlue redeye from Los Angeles to Fort Lauderdale, a 200-mile line of thunderstorms loomed along the Florida coast. The flight would normally require a long reroute to the north and around the severe weather, delaying the expected pre-dawn landing. But with NextGen technology on board, all that was needed was a slight diversion to the south and the passengers landed on time.*

Re-routing around the thunderstorms would have added about 15 minutes to the trip and caused the airliner to burn an extra 60 gallons of jet fuel. This would have pumped an additional 1,200 pounds of exhaust emissions into the atmosphere.

Project/Program Management and ADS-B in Hindsight

Groundwork for Success Had Been Laid Pre-Award

There is agreement among those involved that the FAA, and the Surveillance and Broadcast Services (SBS) Program Office in particular, had been building a solid project/program management foundation even prior to the ADS-B contract being awarded. Ultimately, this facilitated a smooth transition from research through implementation and provided the underpinning for a successful program. The establishment of clear objectives, schedules and milestones early on was supported by a pace and tone that drove individuals to succeed.

The Program Office also incorporated industry input from the beginning. Prior to awarding the contract for ADS-B services, the SBS Program Office made an effort to explain its objectives to various bidders on what were coined "industry days." On these days, bidders were given an opportunity to meet one-on-one with representatives of the program and give feedback on building and performance specifications. The result was an improvement in the overall baseline of the program. Subsequently, the Program Office introduced the Request for Proposal (RFP) process in two separate phases as opposed to the standard one. The first stage solicited technical input, which was then critiqued by the FAA, allowing vendors to address any shortcomings and resubmit during the second stage. "That allowed us," explains one interviewee whose firm was ultimately awarded a contract, "to take their feedback and submit a better proposal… which made for simple, streamlined negotiations [in the end]. We were able to hit the ground running." The two-phase RFP process also proved very conducive to meeting schedules.

Consistent, Bold Leadership was Essential

Another area in which agreement exists is the pivotal role leadership played in the success of this program, especially at the development and early implementation stages. For starters, the lead program manager on ADS-B provided his internal workforce, as well as external partners and stakeholders, with a clear roadmap that would not accept anything short of success. The lead program manager had established a reputation for

> *"As much as there was sound program management going on [at the FAA], leadership was still the main factor leading to the success of this program."*

[11] http://www.faa.gov/nextgen/snapshots

taking programs from concept to deployment successfully, and ADS-B was no exception. His leadership effectively managed expectations and identified key documents and control mechanisms that were necessary "to take the program from beginning to end, so we stayed focused on the work we needed to do," says one interviewee.

Success Spreads Easily

Over the years, the success of the ADS-B program, both individual components as well as overall culture, has found its way into other programs and taken on wider breadth within programs. This is due in part to the typical movement of key individuals around the FAA who "lived it and now own it," and ultimately grew the culture, says one interviewee. ADS-B encouraged everyone to be intentional in their decision-making. It has become much more common to challenge oneself to doing things differently than in the past, to do everything with regard to the baseline or to consider the service-provider approach or, more generally, to find cheaper alternatives. These represent just a few examples of the change in mindset. One interviewee explains it more eloquently: "It's about being intentional in all your decisions…you didn't see that back in the day, and you don't see it across all programs. We are branching this culture, expanding it – it's taking root, but there is still room to grow."

> Standardization represents mature project management practices.

The strong reliance on project/program management principles, activities and tool sets allowed this culture to spread easily throughout the administration. Team members concur that project/program management was valued, if not always perfectly understood (applying EVM, for example), from day one, as external partners worked very closely with the lead program manager. As one interviewee explains, it was organic: "We weren't told to do it and check a box. We knew it was integral to the daily execution of the program." They describe an environment, in vivid contrast to other federal agencies and offices, where project/program management success may be dependent on the experience of one individual, usually a program manager brought in from elsewhere to manage a single program. More often than not, that individual "burns himself out, and if he goes away, the program fails. We have a succession of things, a structure, that ensures a continuity, that we can repeat this."

"We not only embrace it, but we live it… we come from varying backgrounds – military, industry or vice versa – others are lifelong federal employees, and yet the skill sets and shared knowledge have been crucial. It helps ensure that we cross-train, cross-pollinate, and not revisit mistakes we made last time," he continues.

Leadership Firmly Rooted in Mature Project/Program Management Principles

> *"ADS-B is a shining example of successful program management. I am proud to say I have been part of the team since day one."*

According to one interviewee, the Program Office applied aggressive timelines and strict management discipline to this endeavor from the beginning, to the awe of other programs in the portfolio. The Program Office also established an objective statement for the program, instituted a governance process, and identified the internal and external mechanisms critical to success early on. The project/program management plan created was based on core project/program management principles. Explains one interviewee, "A lot of those esoteric program management products that they say you're supposed to do, well, we actually did from day one." Following project/program management processes and structure while tailoring it to the specific needs of the program, these strategies worked to help everyone involved stay focused while being pulled in many different directions. As a result, an already mature project/program management culture advanced even further.

Skilled Management Style

The Lead Program Manager was able to successfully manage the many disparate areas of risk that were encountered, whether they were technical, programmatic or political risks, while allowing his workforce to not only stay focused but also to remain highly motivated throughout. He expected a lot from his team and in turn, they expected a lot of themselves. "[The lead program manager] is a straight shooter," says one interviewee. "If he says he is going to do something, he does it with complete transparency." An additional outcome: the people that work for him felt like he always had their backs – or "like they have top cover" which, in turn, allowed them to take the considered risks that led to success. "Everyone was very results-oriented and driven," this interviewee continues. Many point to this emphasis on complete transparency as a factor that helped motivate the workforce and keep level of mutual respect high.

Surmountable Challenges

Although deemed an overall success to-date, ADS-B was not without its challenges. To keep these in perspective, comments one interviewee, "We were building something that's never been built before." Its size (portfolio and stakeholders involved), timeline and complexity alone were unprecedented and required additional work and innovative problem solving. Some hurdles were larger than others, but none of these hurdles were insurmountable. The following section highlights both the hurdle and the solution, where applicable.

- **Coordination and integration was difficult, as was applying EVM, across multiple programs, some without any reporting requirements, let alone experience with EVM.** Experienced managers set up systems using EVM techniques and scheduling, and demanded regular reporting. "The cultural change from beginning to now was amazing – they really embraced it and adopted it," says one interviewee.

- **While attempting to build the business case, one airline in particular felt the main advantage to ADS-B was limited to flying over water,** whereas "traditional coverage still works fine over Des Moines," thus producing limited benefits to his airline. "We need to make more things happen," says one interviewee, speaking specifically about multiplying the number of antennas deployed for increased surveillance and ultimately better service over land, as well as water.

- **Bringing Europe up to speed.** The necessary harmonization between the domestic FAA requirement and the European version has not been figured out. While the United States has one governing air traffic control body in the FAA, the European Union has to coordinate among 20 countries and that takes more time. Fortunately, the solution is in the form of a software update which, once agreed upon, will be relatively simple to implement. The FAA created a committee charged with moving this issue forward.

- **External stakeholders express concern as the program enters "twilight" mode.** Having achieved most of its implementation and many of its operational goals, a program will naturally begin to ramp down and identify resource areas where cuts can be made.

> *"The big picture hurdles are behind us. Production mode, rolling it out nationwide, that is going well…in some cases we are just waiting for the automation platforms to catch up."*

- **The twilight phase introduces additional concerns for external stakeholders.** The business case was designed to be a foundation on which to develop future applications to improve safety and efficiency. A large return on investment would not materialize until later phases. The second wave of investments is set to hit the FAA in 2015 and stakeholders worry that momentum is dwindling. One interviewee expresses concern: "There is now an opportunity to make much smaller investments, but get much larger returns since we've laid that infrastructure. We need to continue that momentum and ensure people finish the story in terms of getting more ADS-B applications into the NAS." Another interviewee attempts to explain: "It's not lost, I just think it's competing with other priorities."

- **Air traffic controllers expressed initial dismay at the decision to take the service- provider approach,** since they interpreted the thinning and decommissioning of some of the legacy radar systems to mean job loss. Other internal stakeholders worried the approach was less cost effective than owning it inside. While support for the acquisition strategy was eventually won, both internally through discussions with the labor unions and externally with airlines, pilots and aircraft manufacturers, it was not an easy task since it was not business as usual for the FAA. In the end, the controllers and others understood that ADS-B was not taking away jobs, but rather adding jobs through an additional layer of surveillance.

- **Initial support from the airlines could be described as "adequate" at best.** Like other stakeholders, the airlines came to the table with their own agendas. Although they believed in the future of the program, they were not necessarily excited about "publishing a rule that would force them to spend money and put things on their aircraft on a timeline we desired, not theirs…," explains one interviewee. The Program Office worked diligently to gain the support of this community by asking for its input; the rule was eventually approved and published within one month of its due date.

- **Benefits can be slow to materialize.** Although ADS-B gives controllers and pilots extended coverage and increased surveillance, benefits have been slower to realize than had been hoped for, due to delays in aircraft equipage. On the manufacturing side, the decision to extend the rollout, compounded by an economic recession, meant that resources had to be spent before knowing the depth of consumer demand. Further complicating execution, explains one interviewee, is that "the rollout is being done in the context of Europe and the rest of the world. Most manufacturers don't do anything until both the United States and Europe have decided what they are doing. Although the United States had locked in all requirements by 2010, Europe… was still debating, and this resulted in a delay in engineering" that hampered sales.

- **Too many initiatives at one time may challenge implementation.** Due to rapidly changing technology, new initiatives are always being introduced. "We rush to get something done. We miss things," says one interviewee. "We end up delaying programs… at times it would be better to identify four or five and do them correctly instead of having 15 tentacles going out there." The Program Office, they say, exerts effective management of its initiatives and works hard to achieve collaboration among all of its programs.

- **Overall there appears to be a decline in general communication with stakeholders.** As a program begins to twilight, it naturally loses visibility, and communication with stakeholders correlates with that. "During the key phase, it was very active, there were frequent articles in the trade journals… execution mode is less interesting to write about," admits one interviewee. Furthermore, there is no longer a strong, consistent message from the FAA to the broader community, especially that of "second-tier" stakeholders such as operators, suppliers and installers. Their hope is the Program Office will "re-up" communication as they approach 2020, re-engage stakeholders and keep interest levels where they need to be. After all, the ADS-B equipment will have to be put on more than 100,000 airplanes, which will take time and effort and will require input and cooperation from manufacturers. "We are trying to go out there as [avionics] manufacturers and say, 'Hey we've built the equipment, it's available, you have six years to buy it.'" Notably, since these interviews were conducted, the FAA has organized a "Call to Action" for October 2014 to engage these stakeholders in an effort to equip.

- **Constant changes in management personnel, while not unusual – promotions, retirements, etc. – create a revolving door**. This means newcomers have to be brought up to speed with the way things were done previously, processes that worked in the past, and general expectations, expending valuable time and energy. "It's nothing intentional," says one interviewee, "It's just a fact of life." In an ideal world you create a process that results in a learning organization that captures lessons learned.

LESSONS LEARNED/BEST PRACTICES

Given their overall positive experiences building the ADS-B program, study participants were eager to share feedback on best practices, as well as lessons learned. Participants provided feedback on project and program activities, principles and processes, including performance measures, risk identification, stakeholder engagement and other practices.

- **Program milestones and an aggressive schedule.** Interviewees concur that, as "wild" and "crazy" as the schedule was, it drove people to succeed. It could have backfired, overwhelmed the team, but fortunately it did the opposite. It enabled people to take pride in their work and not settle for less than accomplishing what they set out to do. A final rule was published less than a month after it was promised (May vs. April 2010), a time-consuming process that normally takes much longer to complete.[12] According to one interviewee, "It was absolutely crazy. No one imagined we would [publish that quickly]. To miss by less than a month was pretty impressive."

- **Multiple, coordinated performance measures**. Inherent in the milestones were objective measures of performance that encompassed finance, scheduling and other goals. As one interviewee says, "Prior to this program we had not had as much religion around objective measures of performance… we've grown to really believe in measuring performance."

"You can't control what you don't measure."

- **Greater reliance on standardization of processes.** As internal staff experienced first-hand, the value of certain processes (EVM, in particular, but many others as well), an assumption that processes could and should be relied upon, became more commonplace. Again, it was about finding the right balance between process and flexibility. "We were never process-encumbered," points out one interviewee, "but now people are asking, as they do things regularly or repetitively in other projects and programs, 'What is the process for doing this?' It's been an amazing transformation."

- **Have a Plan B.** Setting milestones has proven essential to success. But trying to meet those milestones required some degree of flexibility and foresight. Government, for example, with its infinite number of rules and requirements concerning zoning, permits, environmental concerns and so on, often requires that there be a backup plan to stay true to cost and schedule. A new mindset developed among those involved, both in government and private industry, of, "What's Plan B? What's the workaround when you come to a barrier?"

- **Risk identification.** Described by one interviewee as a "brutal, introspective and transparent" approach, the Program Office encouraged the admittance of risk and problems early on. As a result, it was able to efficiently allocate and manage those resources and to pre-empt and solve problems. "I've not come across that elsewhere," he continues. "It should be brought, not only elsewhere in the FAA, but also in the federal government. I'm glad they did it."

- **Strategic engagement of all stakeholders.** As a result of the decision by the Program Office to engage both internal and external stakeholders and keep them engaged, the program has managed to avoid many of the usual pitfalls, such as lack of continuity of congressional or FAA funding or

[12] A final rule required all aircraft flying in a specified airspace would have to have the equipment for ADS-B "out" by 2020.

> *"Any time you want to put anything into the NAS – not that we agree all the time - but the more input you get from the controllers, the better the chances of success at implementation. Controllers by nature are stubborn and highly motivated, it's got to be done correctly and work correctly before they will even entertain change."*

resistance (internal or external), that creates delays. "The lack of engagement has created problems elsewhere while ADS-B hasn't had those problems," says one interviewee. By encouraging frank, open and regular dialogue among the various parties, ADS-B was able to circumvent some problems and fix others in a timely, cost-efficient manner.

- **Collaboration was vital.** The hallmark of stakeholder engagement was collaboration. The Program Office encouraged parties to work and problem-solve together. "There were no closed-door policies," says one interviewee. "Management was very open to change. They listened to the operational side, to the controllers, and were willing to change as needed."

- **Hiring like-minded contractors.** An emphasis on transparency helped to ensure a productive working relationship with ITT Exelis, the manufacturer of the ADS-B ground infrastructure and service provider. It did not hurt that the contractors also believed in the same overriding principle of transparency, not just transparency, but also early identification of risk and joint problem-solving. "It was interesting to see the leadership of the program managers complemented by the same type of behavior on the contractor side," recalls one interviewee. "It was a fantastic fit."

In addition to these top-of-mind recommendations that resulted in program success, interviewees placed a lot of emphasis on the following factors:

- **Executive sponsorship was critical in the case of ADS-B.** Not only was executive level support forthcoming, but the ADS-B program was prioritized by top-level executives who involved themselves heavily in the planning stages, helping to set aggressive goals and timelines. "At the time, the FAA Administrator really wanted this, she drew aggressive lines in the sand, 'These are dates I want it to meet,' and so forth," recalls one interviewee. "That gave us the extra impetus" to perform well."

- **Regulatory support** was identified as necessary and the regulatory side of the FAA was brought in early. The Program Office understood the value of including the avionics side of the FAA in the building of ADS-B; its inclusion, in turn, helped bolster executive-level support. "I'm going to have the people who influence the avionics right there with me, on board as part of the process," explains one interviewee, denoting the strategic mindset that encouraged teamwork and collaboration.

- **Intentional communication**, meaning all communication that flowed from the Program Office was strategic in nature, designed to convey clear and consistent direction and maintain a high level of morale. One interviewee describes the communication plan put out by the Program Office as "impressive." "The necessary processes [were built up], a communications lead was assigned to ensure consistency (communicating status, benefits, capabilities, etc.) depending on what inquiry needed a response to and where. The data flow was, and is, controlled to ensure the right people are getting a consistent message."

CONCLUSION: THE FUTURE OF ADS-B

A tremendous amount has been accomplished since the program launched in 2006, with tangible gains in increased, modernized and improved surveillance and, subsequently, air safety. Systems such as ADS-B are helping to guide and track aircraft more precisely and identifying more direct routes. The shift to smarter technologies is making air travel safer, more convenient, and more environmentally friendly. "That is a pretty big accomplishment. I look forward to [the future]," says one interviewee. Beyond ADS-B, the long-range potential of its parent program, NextGen, has yet to be realized and, according to both public and private sector experts, that potential is limitless.

But there is more work left to do and milestones to achieve in order to fulfill the mandate to equip more American aircraft with the requisite avionics by 2020. Currently, there are over 3,800 aircraft with rule-driven ADS-B avionics, leaving approximately 7,500 air transport aircraft, 13,500 Department of Defense aircraft, and 200,000 general aviation/air taxi aircraft remaining to be equipped.[13]

From a project management perspective, it does not appear likely that program management behavior will undergo major changes, either around ADS-B or future programs or projects. The practices established by the Program Office at the outset, ones that would enable the program to meet lofty goals, remain entrenched: strong leadership and management skills, effective, transparent communication (internal and external), use of proven processes and performance measures, and a strategic, collaborative relationship with stakeholders. As the ADS-B program gained traction early on, and then proceeded to meet every milestone on time and within budget, respect for project/program management escalated, and a culture was transformed. Looking back, says one interviewee, the use of project/program management proved very effective. "We accomplished a lot. We changed the way air traffic is done in the NAS."

[13] Equipage data provided by the ATO, September 2014.

ABOUT THE STUDY

The goal of this study is to highlight the management (principles, practices and activities) of the Automatic Dependent Surveillance-Broadcast (ADS-B) program to better understand and learn from its success in order to share insights with others in the FAA, as well as those in other agencies. The study examines ADS-B from the perspective of project/program management and pays specific attention to areas of success – how it is defined and measured, as well as leadership, governance, processes, communication and other formal aspects of project and program management. The perspectives of those deemed essential to the success of this program were sought and incorporated: leadership (program manager/program office), contractors (airline manufacturers), stakeholders (airlines, airline industry experts, lobbyists) and workforce (labor union representatives).

A note to the reader: Agencies within the federal government often use "program" and "project" interchangeably. Where possible both terms are used to avoid confusion.

Methodology

The Project Management Institute (PMI®) hired M/A/R/C® Research Inc. to design and conduct a series of in-depth telephone interviews with individuals deemed responsible and relevant to project/program management success within the Federal Aviation Administration (FAA). ADS-B illustrated many successful components of project/program management over the course of many years and, as such, was selected as the subject of this study by a joint effort between PMI and the qualitative research team at M/A/R/C®.

- A total of seven (7) in-depth telephone interviews were conducted between March 3 and 17, 2014, and incorporated the following roles:
  - Lead Program Manager (ADS-B), Director of Surveillance & Broadcast Services, Air Traffic Organization, Federal Aviation Administration
  - Lead Business Case Analyst (ADS-B), Senior Director of Civil Programs, MCR, LLC
  - Lead Implementation Manager (ADS-B), Surveillance & Broadcast Services Group Manager, Air Traffic Organization, Federal Aviation Administration
  - National Operations Manager (ADS-B), Director of Strategic Airspace Programs, JetBlue
  - Program Manager (ADS-B), Program Director, Exelis, Inc.
  - Vice President, Operations, General Aviation Manufacturers Association (GAMA)
  - Former National Air Traffic Controllers Association (NATCA) representative, Senior Air Traffic System Specialist, Regulus Group, LLC

PMI recognizes all those who agreed to be interviewed for this study but, having promised anonymity, those names shall not be revealed.

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Project Management Institute is the world's leading not-for-profit professional membership association for the project, program, and portfolio management profession. Founded in 1969, PMI delivers value for more than 2.9 million professionals working in nearly every country in the world through global advocacy, collaboration, education and research. PMI advances careers, improves organizational success and further matures the profession of project management through its globally recognized standards, certifications and credentials, resources, tools academic research, publications, professional development courses, and networking opportunities. As part of the PMI family, Human Systems International (HSI) provides organizational assessment and benchmarking services to leading businesses and government, while ProjectManagement.com and ProjectsAtWork.com create online global communities that deliver more resources, better tools, larger networks and broader perspectives.

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APÉNDICE C.-

NAV CANADA AIMS TO COVER MAJOR ROUTES WITH ADS-B.

Air Transport

Nav Canada Aims To Cover Major Routes With ADS-B

Aviation Week & Space Technology
07/07/2008 , page 44

Adrian Schofield
Washington

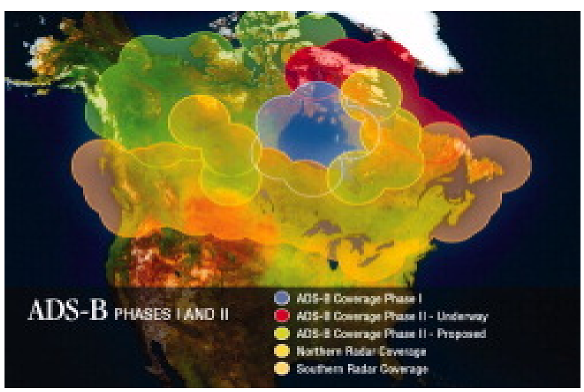
Nav Canada targets efficiency gains on crucial air routes

Printed headline: ADS-B Pioneer

Nav Canada is planning an ambitious deployment schedule for new GPS-based air traffic control technology, bringing fuel-saving and safety benefits to major intercontinental air routes that are currently beyond radar range.

The Canadian air traffic service provider will be one of the first to use automatic dependent surveillance-broadcast (ADS-B) for en-route ATC. This system offers more precise—and cheaper—surveillance than radar, allowing controllers to make traffic flows more efficient. Many other ATC organizations are planning to create ADS-B networks, but few are moving so quickly.

Nav Canada is preparing for the operational debut of ADS-B later this year in the Hudson Bay region, a crossroads for many of North America's international air traffic routes. The next step, targeted for 2009, will be pushing ADS-B coverage out from Canada's northeast coast to encompass the final stages of many transatlantic flights. Looking further ahead, **Nav** Canada aims to bring ADS-B to its northern airspace to cover part of the increasingly busy polar routes.



***Nav** Canada's Hudson Bay ADS-B coverage is pictured in blue, with the northeast expansion in red. Greenland coverage is not shown.Credit: **NAV** CANADA*

The advantages of ADS-B include reducing en-route separation dramatically, and allowing aircraft to climb to optimal altitudes much faster. Canada has the ideal environment for ADS-B—vast areas that are without radar coverage, but are crossed by significant traffic streams.

Controllers must essentially keep aircraft in a box about 80 mi. long and 60 mi. wide when they are flying outside of radar coverage. With ADS-B, **Nav** Canada wants to reduce separation to 5 mi., easing route congestion. Because they require less airspace, controllers have more flexibility to maneuver aircraft and requests for altitude changes can be accommodated more easily.

Introducing ADS-B will help airlines reduce fuel burn, says Ross Bowie, **Nav** Canada's director of air navigation service design. "The business case is very clear for this [system]—we have to push harder now to reduce [costs]," Bowie says. Studies show that reducing separation in the Hudson Bay area alone could cut airline fuel costs by about C$10 million ($9.8 million) a year.

The International Air Transport Assn. agrees with **Nav** Canada's assessment of ADS-B benefits. The system will result in "quite substantial" fuel savings if altitude changes can be approved more often, says IATA's director of infrastructure strategy David Behrens. Aircraft generally operate more efficiently at higher altitudes as their fuel load gets lighter, so allowing them to climb can reduce fuel burn by as much as 500 kg. per hour, Behrens says.

Nav Canada needs regulatory approval from Transport Canada before it can apply reduced separation using ADS-B, says Bowie. The company is confident it has made the technical case that ADS-B is at least as accurate as radar for surveillance purposes. **Nav** Canada also has to prove its case for reduced separation on oceanic routes to ICAO.

The Hudson Bay region will be the first to see ADS-B. Sensis Corp. is providing ground units that have been installed at five locations around the bay, covering 250,000 sq. mi. of airspace. Bowie says ADS-B will initially be used in tactical situations from November, meaning controllers will reduce separation only when they see two or more aircraft that are equipped.

Based on signals being received by the Hudson Bay stations, **Nav** Canada believes 60-70% of aircraft using this airspace are properly equipped—although it will still take time for airlines to receive regulatory approval. Greater benefits will come when airspace can be segregated for equipped and non-equipped users, a concept the company has been discussing with its airline customers.

Nav Canada will also install ADS-B ground units on its Northeast coast and in Greenland, to push its surveillance capabilities further off its coast. This will allow coverage of part of the North Atlantic track system. The aim is to establish three stations on the Greenland coast, and around 11 on the Canadian coast, says Bowie. This ADS-B network probably won't be operational until late 2009 or 2010.

Initially, ADS-B will be used to allow westbound transatlantic flights approaching Greenland to climb to optimum altitudes about 1.5-2 hr. earlier than they can now. Eventually, aircraft will be able to take advantage of reduced in-trail separation for the entire crossing, although this will obviously require coordination with other ATC agencies.

The next step will be extending ADS-B coverage into the far north of Canada, which is tentatively targeted for 2013-14. "With polar route traffic growing, the pressure is really on us to provide better service in this northern airspace," Bowie says.

La innovación que le ahorrará millones a las aerolíneas y a los viajeros

FORTUNE EN ESPAÑOL15 MAYO, 2018

Aerion, Iridium y otros proveedores de tráfico aéreo internacional están implementando una nueva tecnología que hará que los costos sean menores.

Es un buen momento para ser una aerolínea.

Los bajos precios del combustible, el crédito barato y la creciente demanda de viajes aéreos permitieron a las aerolíneas aumentar sus flotas y transportar 4,100 millones de pasajeros sin precedentes en 2017, un aumento del 7.1% con respecto al año anterior, según la Autoridad de Aviación Civil de las Naciones Unidas.

A pesar del aumento de la demanda, los clientes ahora pagan más por sus vuelos que nunca, y a su vez, hay una competencia feroz entre los aviones que pelean por transitar en algunos de los espacios aéreos más ocupados del mundo.

Los controladores de tráfico aéreo se enfrentan a un reto particularmente espinoso al enrutar a un número creciente de aeronaves a través de los más transitados corredores oceánicos, como el Atlántico Norte, donde el tráfico de radares terrestres es limitado y no se puede rastrear aviones en tiempo real.

Se busca conectar el tráfico aéreo global a una red de comunicaciones basada en satélites.

Con solo una vaga idea de la ubicación precisa de cada avión en particular, los controladores a menudo mantienen un espacio de hasta 100 millas entre aeronaves, una precaución de seguridad que obliga a los pilotos a tomar rutas que son más largas y requieren quemar más combustible.

“Uno pensaría que las aeronaves vuelan directamente desde el punto A al punto B”, dice Don Thoma, CEO de Aireon, la compañía de ingeniería de aviación. “Pero (las rutas de vuelo) pueden parecerse más a un espirógrafo”, agrega.

Entre Aireon, Iridium (el operador global de satélites de comunicaciones) y un puñado más de proveedores de control de tráfico aéreo, están tratando de cambiar eso al conectar el tráfico aéreo global a una red de comunicaciones basada en satélites.

A través de la tecnología conocida como ADS-B (Transmisión Automática Dependiente de Vigilancia), Aireon podrá rastear aviones comerciales en cualquier parte del mundo en tiempo real, incluso en tramos remotos del océano, lo que permitiría a los controladores espaciar más de manera más estecha las aeronaves y darles a los pilotos la capacidad de seleccionar mejores rutas y altitudes.

El resultado: tiempos de vuelo más cortos, menor consumo de combustible, emisiones de carbono reducidas, viajes más suaves y un ahorro potencial de cientos de millones de dólares anuales tanto para aerolíneas como para compañías de carga aérea como UPS y FedEx.

Controlando los cielos

Para gestionar el tráfico aéreo de manera óptima, los controladores y los pilotos necesitan tres cosas.

En primer lugar, los pilotos deben conocer su ubicación precisa; después, los controladores deben comunicarse de manera rápida y confiable con todos los pilotos en su espacio aéreo y en tercer lugar -para hacer que toda la empresa funcione de manera eficiente y segura- los controladores deben ser capaces de rastrear las ubicaciones precisas, los permisos, las altitudes y las velocidades de cada aeronave en un área determinada.

Dondequiera que uno de estos componentes falte o no sea confiable, los controladores deben recurrir a precauciones de seguridad como espaciar las aeronaves a decenas de millas de distancia para asegurarse de que no vuelan demasiado cerca la una del otra.

Actualmente, las aeronaves comerciales tienen un GPS a bordo y las comunicaciones de voz entre los controladores y los pilotos son en general buenas (y cada vez mejores).

La capacidad de rastrear un avión en tiempo real, conocida como “vigilancia” en el lenguaje de la aviación, es mucho más impredecible.

La tecnología de ADS-B proporciona un grado sin precedentes de vigilancia en tiempo real.

Los sistemas de radar basados en tierra proporcionan una vigilancia decente cuando las aeronaves están sobre tierra, pero el 70% del planeta carece de una cobertura de radar convencional.

En algunos casos, una aeronave que vuela fuera del alcance del radar terrestre ocasionalmente transmitirá datos al suelo mediante el envío de una señal a un satélite en órbita, pero las transmisiones son lo suficientemente infrecuentes como para que un avión pueda viajar más de 100 millas entre ellas.

La tecnología de ADS-B sobrepone el monitoreo en tiempo real al sistema GPS y el sistema de comunicación por voz del piloto.

Un transpondedor ADS-B en un avión envía automáticamente los datos de vuelo pertinentes a los receptores en tierra dos veces por segundo. En otras palabras, las computadoras de la aeronave se comunican automática y continuamente con los controladores en tierra, lo que proporciona un grado sin precedentes de vigilancia en tiempo real.

Implementación en acción

La Administración Federal de Aviación de Estados Unidos ya ha desplegado receptores ADS-B sobre el terreno de este país y junto con otras autoridades de aviación civil de todo el mundo ha ordenado que todas las aeronaves integren la tecnología ADS-B a principios de 2020.

La red espacial de Aireon, una vez completa, cubriría cada kilómetro cuadrado de espacio aéreo que las estaciones terrestres ADS-B no pueden, llenando un enorme vacío en la cobertura y completando la red.

La compañía ya cuenta con bases ADS-B operando a bordo de 40 satélites Iridium lanzados recientemente, el primero de los eventuales 75 satélites que reemplazarán a la constelación envejecida de la compañía. Los satélites restantes se lanzarán a bordo de varios cohetes SpaceX Falcon 9 a lo largo de este año.

La flota operativa eventual de 66 satélites -nueve de los 75 servirán como repuestos- ofrecerá una cobertura global Aireon que otros operadores de satélites no pueden tocar.

El uso de los receptores ADS-B ayudaría a ahorrar 33 millones de galones de combustible al año.

Por ejemplo, Inmarsat, con sede en Londres, recibe y transmite datos “ping” desde aviones que operan en todo el mundo (su red fue la última en enterarse del MH370 antes de que desapareciera), pero su flota de 13 satélites geosincrónicos cubre solo una parte del mundo océanos.

El alcance global de la red satelital de Iridium pisiciona a ésta y a Aireon para tener una ventaja distintiva en el ADS-B basado en el espacio en el futuro previsible, una inversión que ya está empezando a generar dividendos.

“Ahora que Aireon está obteniendo datos en vivo, aún no es una cobertura total, pero en realidad obtienen algo así como mil millones de puntos de datos por mes y con solo unos 30 satélites en línea, realmente se puede ver qué tan ricos son los datos”, dice Joe Bertapelle, director de programas estratégicos de espacio aéreo para la aerolínea JetBlue. “Además de donde hay margen de mejora”. agrega. El margen de mejora es significativo, según las fuentes dentro y fuera de la industria.

¿Y cuáles son los beneficios?

En el Atlántico Norte, los operadores que usan ADS-B espacial podrían ahorrar más de 33 millones de galones de combustible al año, lo que se traduce en muchos millones de dólares ahorrados y la reducción de emisiones de gases de efecto invernadero en más de 320,000 toneladas métricas, dice NAV CANADA, el operador canadiense de tráfico aéreo que también es socio en Aireon.

Un estudio de la Universidad de Purdue, publicado a finales de 2016, tomó un aspecto más macro de ADS-B basado en el espacio.

Si se implementara una red de este tipo a nivel mundial, las aerolíneas podrían ahorrar más de 110 millones de galones de combustible anualmente en 2020, casi el equivalente a retirar 300,000 automóviles de la carretera.

Para las aerolíneas, no toma mucho para hacer una gran diferencia en los resultados.

“Reducir de forma segura el estándar de separación de su mínimo actual de 30 millas marinas a 15 millas náuticas significa que podrán ahorrar algo así como 700 dólares por vuelo a través del Atlántico Norte”, dijo Thoma, el CEO de Aireon, “Eso representa aproximadamente 300 dólares o más millones por año en ahorros de combustible solo para el Atlántico Norte”.

Pero las aerolíneas no tienen que operar rutas intercontinentales de larga distancia para cosechar los beneficios. “Todo lo que tienes que hacer es ahorrar 200 dólares por vuelo y eso se convierte en un número anual muy grande”, dice por su parte Bertapelle.

Jugosas ganancias para la industria

Si un vuelo de tres horas desde Nueva York a San Juan puede tomar ventaja de mejores altitudes, una escalada más optimizada y una trayectoria más directa para recortar incluso 100 dólares del costo operativo, eso es una ganancia para una aerolínea que pone en vuelo cientos de vuelos cada día.

“No quiero dar la impresión de que soy un defensor de Aireon y esa es mi próxima carrera”, dice Bertapelle. “Tienen que probar su camino hacia el espacio aéreo. Todo lo que digo es que todo lo que hemos modelado en los últimos tres o cinco años hasta ahora cumple o excede las expectativas”, agrega.

Aunque los beneficios de ADS-B, en general, y del ADS-B basado en el espacio, en particular, ya se están infiltrando en la industria, dice Bertapelle, los pasajeros quizá no notarán cambios significativos inmediatamente.

Las aerolíneas todavía están adaptando aeronaves más viejas con transpondedores ADS-B antes del plazo de enero de 2020 de la FAA, y hasta que la industria se acerque a la adopción de toda la flota, los controladores continuarán administrando de manera segura el tráfico aéreo transoceánico al poner millas y millas de distancia entre los aviones.

Pero el cambio está en el horizonte.

“Diría que para el tercer trimestre de 2019 debería verse considerablemente diferente de lo que es hoy”, dice Bertapelle. “Deberíamos ver más del 80% equipado a mediados de 2019, y una vez que llegue a esa marca del 80%, la FAA comenzará a gestionar el tráfico de manera diferente”.

FUENTE:

https://www.fortuneenespanol.com/finanzas/la-innovacion-que-le-ahorrara-millones-a-las-aerolineas-y-a-los/

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APÉNDICE D.-

COSTO DEL COMBUSTIBLE

Jet Fuel Daily Price

1.92

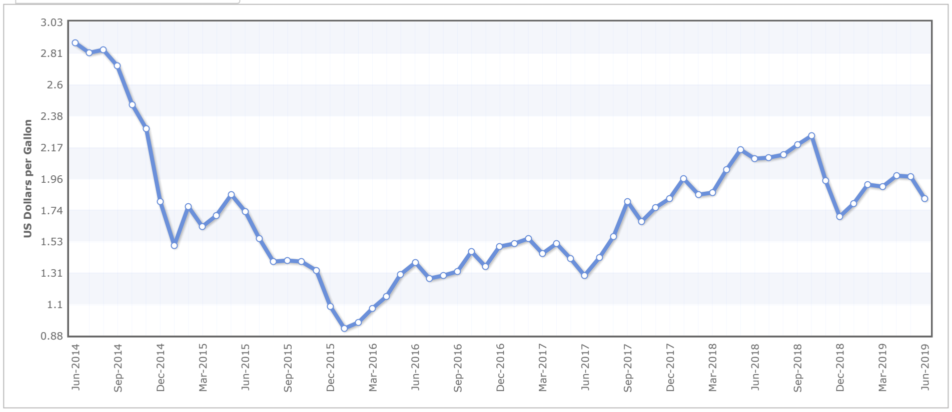
U.S. Gulf Coast Kerosene-Type Jet Fuel Spot Price FOB, US$ per gallon
As of: Tuesday, July 23, 2019
Source: US Energy Information Administration

Jet Fuel Monthly Price - US Dollars per Gallon

Range

Jun 2014 - Jun 2019: -1.066 (-36.98 %)

6m (?commodity=jet-fuel) 1y (?commodity=jet-fuel&months=12) 5y
10y (?commodity=jet-fuel&months=120) 15y (?commodity=jet-fuel&months=180)
20y (?commodity=jet-fuel&months=240) 25y (?commodity=jet-fuel&months=300)
30y (?commodity=jet-fuel&months=360)



Description: U.S. Gulf Coast Kerosene-Type Jet Fuel Spot Price FOB

Unit: US Dollars per Gallon

Currency: US Dollar

Compare to: Nothing

Source: Energy Information Administration (http://www.eia.gov/dnav/pet/pet_pri_spt_s1_m.htm)

See also: Energy production and consumption statistics (../energy/)

See also: Top commodity suppliers (suppliers/#jet-fuel)

See also: Commodities glossary (glossary/) - Definitions of terms used in commodity trading

Month	Price	Change
Jun 2014	2.88	-
Jul 2014	2.82	-2.29 %
Aug 2014	2.84	0.78 %
Sep 2014	2.73	-3.87 %
Oct 2014	2.46	-9.86 %
Nov 2014	2.30	-6.63 %
Dec 2014	1.80	-21.59 %
Jan 2015	1.50	-16.94 %
Feb 2015	1.77	18.05 %
Mar 2015	1.63	-7.76 %
Apr 2015	1.70	4.48 %
May 2015	1.85	8.64 %
Jun 2015	1.73	-6.33 %
Jul 2015	1.55	-10.57 %
Aug 2015	1.39	-10.33 %
Sep 2015	1.40	0.43 %
Oct 2015	1.39	-0.29 %
Nov 2015	1.33	-4.67 %
Dec 2015	1.08	-18.40 %
Jan 2016	.93	-14.05 %
Feb 2016	.97	4.62 %
Mar 2016	1.07	9.87 %
Apr 2016	1.15	7.30 %
May 2016	1.30	13.25 %
Jun 2016	1.38	6.39 %
Jul 2016	1.27	-7.96 %
Aug 2016	1.30	1.81 %
Sep 2016	1.32	1.85 %
Oct 2016	1.46	10.46 %
Nov 2016	1.36	-6.93 %
Dec 2016	1.49	9.96 %
Jan 2017	1.51	1.54 %
Feb 2017	1.55	2.18 %

Mar 2017	1.45	-6.59 %
Apr 2017	1.51	4.50 %
May 2017	1.41	-6.49 %
Jun 2017	1.30	-8.29 %
Jul 2017	1.42	9.42 %
Aug 2017	1.56	10.16 %
Sep 2017	1.80	15.31 %
Oct 2017	1.66	-7.83 %
Nov 2017	1.76	6.09 %
Dec 2017	1.82	3.24 %
Jan 2018	1.95	7.43 %
Feb 2018	1.85	-5.28 %
Mar 2018	1.86	0.49 %
Apr 2018	2.02	8.45 %
May 2018	2.16	6.95 %
Jun 2018	2.09	-3.02 %
Jul 2018	2.10	0.38 %
Aug 2018	2.12	0.95 %
Sep 2018	2.19	3.35 %
Oct 2018	2.25	2.74 %
Nov 2018	1.95	-13.52 %
Dec 2018	1.70	-12.80 %
Jan 2019	1.78	5.19 %
Feb 2019	1.91	7.29 %
Mar 2019	1.90	-0.63 %
Apr 2019	1.98	3.94 %
May 2019	1.97	-0.25 %
Jun 2019	1.82	-7.86 %

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APÉNDICE E.- ANNUAL REPORT 2017

Presentación de los resultados estadísticos sobre el transporte aéreo de 20

Tabla 4. Distribución regional del tráfico regular — 2017

Por región estadística de la OACI	Kilómetros recorridos (millones)	Salidas de aeronaves (miles)	Pasajeros transportados (miles)	Pasajeros-kilómetros (millones)	Coeficiente de carga de pasajeros (%)	Toneladas-km de carga (millones)	Toneladas-km de pago (millones)	Toneladas-km disponibles (millones)	Coeficiente de utilización en peso (%)
Total de los servicios (internacionales e interiores)									
Europa	12 633	8 809	1 067 047	2 042 727	84	51 650	249 465	340 581	73
% del tráfico mundial	24,5	24,0	26,2	26,5		23,1	26,4	24,6	
África	1 371	1 043	83 354	161 631	71	4 167	19 758	34 180	58
% del tráfico mundial	2,7	2,8	2,0	2,1		1,9	2,1	2,5	
Oriente Medio	3 696	1 397	217 519	724 147	75	30 787	99 345	153 166	65
% del tráfico mundial	7,2	3,8	5,3	9,4		13,8	10,5	11,1	
Asia y el Pacífico	16 556	11 559	1 485 001	2 607 057	81	86 712	326 684	462 051	71
% del tráfico mundial	32,1	31,5	36,5	33,9		38,8	34,6	33,4	
Norteamérica	14 304	11 083	940 807	1 768 744	83	44 433	206 703	328 771	63
% del tráfico mundial	27,7	30,2	23,1	23,0		19,9	21,9	23,7	
Latinoamérica y Caribe	3 029	2 831	277 466	395 114	81	5 981	43 410	65 744	66
% del tráfico mundial	5,9	7,7	6,8	5,1		2,7	4,6	4,7	
Total	51 588	36 722	4 071 193	7 699 420	81	223 730	945 365	1 384 492	68
Servicios internacionales									
Europa	10 587	5 908	790 652	1 782 198	84	50 412	223 251	303 660	74
% del tráfico mundial	37,5	49,0	47,6	36,7		25,9	33,9	31,8	
África	1 084	528	50 630	137 806	70	4 097	17 431	30 839	57
% del tráfico mundial	3,8	4,4	3,0	2,8		2,1	2,6	3,2	
Oriente Medio	3 447	1 053	178 709	694 470	74	30 732	96 500	148 647	65
% del tráfico mundial	12,2	8,7	10,8	14,3		15,8	14,7	15,6	
Asia y Pacífico	7 880	2 631	423 001	1 429 884	80	76 913	212 185	297 296	71
% del tráfico mundial	27,9	21,8	25,5	29,4		39,6	32,3	31,2	
Norteamérica	3 805	1 314	148 252	610 714	82	27 039	83 245	135 354	62
% del tráfico mundial	13,5	10,9	8,9	12,6		13,9	12,7	14,2	
Latinoamérica y Caribe	1 423	624	69 241	205 856	82	5 157	25 224	38 586	65
% del tráfico mundial	5,0	5,2	4,2	4,2		2,7	3,8	4,0	
Total	28 227	12 059	1 660 485	4 860 927	81	194 349	657 836	954 381	69

Nota.— Las sumas de las distintas regiones quizá no correspondan a los totales por haberse redondeado estos.

Fuente.— Formularios A y A-S de información de transporte aéreo de la OACI, además de las estimaciones de la Organización.

Fuente: https://www.icao.int/annual-report-2017/Pages/ES/the-world-of-air-transport-in-2017-statistical-results.aspx

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APÉNDICE F.- OPERACIONES AÉREAS EN MÉXICO 2011 - 2017.

ESTADÍSTICA OPERACIONAL ENERO A DICIEMBRE 2011

ESTACION		IFR	VFR	TOTAL 2011
ACA	ACAPULCO	17,910	10,327	28,237
ADN	AEROP. DEL NORTE	29,263	26,198	55,461
AGU	AGUASCALIENTES	9,930	3,306	13,236
BJX	EL BAJÍO(LEON)	20,135	4,202	24,337
CEN	CD. OBREGÓN	6,084	14,808	20,892
CJS	CD. JUÁREZ	14,646	3,689	18,335
CME	CD. DEL CÁRMEN	6,473	46,568	53,041
COL	COLIMA	3,259	2,829	6,088
CPE	CAMPECHE	3,541	2,809	6,350
CSL	CABO SAN LUCAS	2,517	9,223	11,740
CTM	CHETUMAL	3,808	1,902	5,710
CUL	CULIACÁN	21,421	34,793	56,214
CUN	CANCUN	113,168	7,762	120,930
CUU	CHIHUAHUA	20,277	10,988	31,265
CVA	CUERNAVACA	1,218	9,972	11,190
CVM	CD. VICTORIA	8,372	7,657	16,029
CZA	CHICHENITZÁ	124	658	782
CZM	COZUMEL	8,242	10,858	19,100
DGO	DURANGO	5,524	14,309	19,833
GDL	GUADALAJARA	101,435	21,488	122,923
GYM	GUAYMAS	1,262	9,879	11,141
HMO	HERMOSILLO	26,384	14,941	41,325
HUX	HUATULCO	6,249	2,247	8,496
LAP	LA PAZ	11,149	16,347	27,496
LMM	LOS MOCHIS	6,485	15,802	22,287
LTO	LORETO	1,305	5,292	6,597
MAM	MATAMOROS	10,186	5,159	15,345
MEX	MÉXICO	340,615	25,753	366,368
MID	MÉRIDA	24,197	4,254	28,451
MLM	MORELIA	10,139	8,752	18,891
MTT	MINATITLÁN	4,122	3,601	7,723
MTY	MONTERREY	95,828	3,925	99,753
MXL	MEXICALI	7,600	6,934	14,534
MZT	MAZATLÁN	24,741	7,947	32,688
NLD	NUEVO LAREDO	8,676	4,454	13,130
OAX	OAXACA	12,360	9,169	21,529
PAZ	POZA RICA	6,830	7,885	14,715
PBC	PUEBLA	7,684	18,117	25,801
PPE	PUERTO PEÑASCO	238	3,643	3,881
PVR	PUERTO VALLARTA	32,966	6,490	39,456
PXM	PUERTO ESCONDIDO	1,917	3,736	5,653
QET	QUERETARO	15,563	6,935	22,498
REX	REYNOSA	19,082	13,551	32,633
SJD	SAN JOSÉ DEL CABO	32,925	1,168	34,093
SLP	SAN LUIS POTOSÍ	16,348	7,008	23,356
TAM	TAMPICO	12,636	10,041	22,677
TAP	TAPACHULA	4,541	3,649	8,190
TGZ	TUXTLA GUTIÉRREZ	10,584	5,593	16,177
TIJ	TIJUANA	35,010	4,956	39,966
TLC	TOLUCA	70,457	20,322	90,779
TNY	TEPIC	2,995	5,694	8,689
TRC	TORREÓN	11,652	6,626	18,278
UPN	URUAPAN	1,272	6,794	8,066
VER	VERACRUZ	25,265	15,943	41,208
VSA	VILLAHERMOSA	16,721	5,976	22,697
ZCL	ZACATECAS	6,605	3,759	10,364
ZIH	ZIHUATANEJO	11,447	3,287	14,734
ZLO	MANZANILLO	5,683	3,117	8,800
SVL	MÉRIDA	60,228	573	60,801
	TOTAL	1,397,294	553,665	1,950,959

ESTADÍSTICA OPERACIONAL POR ESTACIÓN
(ENERO A DICIEMBRE DE 2012)

ESTACION		IFR	VFR	TOTAL
ACA	ACAPULCO	18,118	10,160	28,278
ADN	AEROPUERTO DEL N	28,862	24,296	53,158
AGU	AGUSCALIENTES	11,632	3,210	14,842
BJX	BAJIO LEON)	21,236	3,842	25,078
CEN	CD. OBREGON	5,596	11,855	17,451
CJS	CD. JUAREZ	15,345	3,130	18,475
CME	CD. DEL CARMEN	7,240	48,239	55,479
COL	COLIMA	3,921	3,877	7,798
CPE	CAMPECHE	3,817	2,407	6,224
CSL	CABO SAN LUCAS	3,363	7,887	11,250
CTM	CHETUMAL	3,992	2,021	6,013
CUL	CULIACAN	20,868	32,900	53,768
CUN	CANCUN	120,526	7,506	128,032
CUU	CHIHUAHUA	20,682	12,291	32,973
CVA	CUERNAVACA	1,476	16,075	17,551
CVM	CD. VICTORIA	7,738	6,564	14,302
CZA	CHICHENITZA	97	555	652
CZM	COZUMEL	8,013	11,612	19,625
DGO	DURANGO	5,980	13,761	19,741
GDL	GUADALAJARA	100,224	19,734	119,958
GYM	GUAYMAS	1,061	7,286	8,347
HMO	HERMOSILLO	28,685	15,771	44,456
HUX	HUATULCO	5,284	2,213	7,497
LAP	LA PAZ	11,307	11,675	22,982
LMM	LOS MOCHIS	6,326	14,067	20,393
LTO	LORETO	1,461	4,645	6,106
MAM	MATAMOROS	10,879	5,277	16,156
MEX	MÉXICO	371,361	24,708	396,069
MID	MÉRIDA	23,371	3,871	27,242
MLM	MORELIA	9,942	6,309	16,251
MTT	MINATITLAN	4,063	3,741	7,804
MTY	MONTERREY	100,718	4,782	105,500
MXL	MEXICALI	6,866	6,169	13,035
MZT	MAZATLAN	23,161	7,892	31,053
NLD	NUEVO LAREDO	9,433	4,269	13,702
OAX	OAXACA	13,273	6,909	20,182
PAZ	POZA RICA	7,262	9,595	16,857
PBC	PUEBLA	8,190	17,728	25,918
PPE	PUERTO PEÑASCO	285	3,967	4,252
PVR	PUERTO VALLARTA	32,894	6,247	39,141
PXM	PUERTO ESCONDIDO	2,359	4,071	6,430
QET	QUERETARO	16,830	9,183	26,013
REX	REYNOSA	20,010	11,231	31,241
SJD	SAN JOSE DEL CABO	35,728	1,189	36,917
SLP	SAN LUIS POTOSI	16,913	6,399	23,312
TAM	TAMPICO	13,732	10,684	24,416
TAP	TAPACHULA	4,645	3,923	8,568
TGZ	TUXTLA GUTIERREZ	11,655	5,467	17,122
TIJ	TIJUANA	36,463	4,829	41,292
TLC	TOLUCA	65,620	19,017	84,637
TNY	TEPIC	2,831	4,751	7,582
TRC	TORREON	12,225	6,989	19,214
UPN	URUAPAN	1,175	5,541	6,716
VER	VERACRUZ	25,577	17,036	42,613
VSA	VILLAHERMOSA	18,743	4,651	23,394
ZCL	ZACATECAS	6,386	4,132	10,518
ZIH	ZIHUATANEJO	10,873	3,302	14,175
ZLO	MANZANILLO	6,131	2,461	8,592
SVL	MID	61,254	753	62,007
	TOTAL	**1,453,698**	**534,652**	**1,988,350**

Abreviaturas

IFR Reglas de Vuelo por Instrumento
VFR Reglas de Vuelo Visual
SVL Sobrevuelos Internacionales Centro de Control Mérida

VFR (Visual Flight Rules o Reglas de Vuelo Visual)
IFR (Instrumental Flight Rules o Reglas de Vuelo Instrumental)

ESTADÍSTICA OPERACIONAL POR ESTACIÓN
(ENERO A DICIEMBRE DE 2013)

ESTACION		IFR	VFR	TOTAL
ACA	ACAPULCO	18,123	10,749	28,872
ADN	AEROPUERTO DEL N	27,230	22,198	49,428
AGU	AGUSCALIENTES	11,750	3,227	14,977
BJX	BAJIO LEON)	21,872	3,532	25,404
CEN	CD. OBREGON	5,897	10,758	16,655
CJS	CD. JUAREZ	14,752	2,280	17,032
CME	CD. DEL CARMEN	7,945	47,204	55,149
COL	COLIMA	3,673	3,135	6,808
CPE	CAMPECHE	3,879	2,249	6,128
CSL	CABO SAN LUCAS	3,392	6,814	10,206
CTM	CHETUMAL	2,974	2,585	5,559
CUL	CULIACAN	20,826	33,146	53,972
CUN	CANCUN	129,331	6,961	136,292
CUU	CHIHUAHUA	20,400	12,544	32,944
CVA	CUERNAVACA	1,496	20,410	21,906
CVM	CD. VICTORIA	7,136	5,795	12,931
CZA	CHICHENITZA	61	478	539
CZM	COZUMEL	7,351	10,947	18,298
DGO	DURANGO	6,593	11,592	18,185
GDL	GUADALAJARA	105,854	19,621	125,475
GYM	GUAYMAS	567	6,401	6,968
HMO	HERMOSILLO	28,708	15,132	43,840
HUX	HUATULCO	5,263	1,872	7,135
LAP	LA PAZ	11,354	12,455	23,809
LMM	LOS MOCHIS	5,905	11,936	17,841
LTO	LORETO	2,066	4,010	6,076
MAM	MATAMOROS	9,763	5,196	14,959
MEX	MÉXICO	380,826	35,361	416,187
MID	MÉRIDA	22,977	4,035	27,012
MLM	MORELIA	9,310	5,916	15,226
MTT	MINATITLAN	4,324	3,196	7,520
MTY	MONTERREY	102,718	4,629	107,347
MXL	MEXICALI	6,663	5,439	12,102
MZT	MAZATLAN	24,565	7,200	31,765
NLD	NUEVO LAREDO	7,827	2,915	10,742
OAX	OAXACA	12,406	6,252	18,658
PAZ	POZA RICA	6,770	5,175	11,945
PBC	PUEBLA	8,549	15,265	23,814
PPE	PUERTO PEÑASCO	501	3,763	4,264
PVR	PUERTO VALLARTA	33,092	6,053	39,145
PXM	PUERTO ESCONDIDO	2,656	4,040	6,696
QET	QUERETARO	18,227	11,134	29,361
REX	REYNOSA	19,622	9,617	29,239
SJD	SAN JOSE DEL CABO	37,356	886	38,242
SLP	SAN LUIS POTOSI	14,639	5,067	19,706
TAM	TAMPICO	14,160	8,367	22,527
TAP	TAPACHULA	4,652	4,636	9,288
TGZ	TUXTLA GUTIERREZ	12,172	5,747	17,919
TIJ	TIJUANA	41,031	4,977	46,008
TLC	TOLUCA	69,126	17,999	87,125
TNY	TEPIC	2,698	3,756	6,454
TRC	TORREON	12,538	6,801	19,339
UPN	URUAPAN	1,120	5,802	6,922
VER	VERACRUZ	25,294	12,085	37,379
VSA	VILLAHERMOSA	18,748	4,311	23,059
ZCL	ZACATECAS	5,790	3,156	8,946
ZIH	ZIHUATANEJO	9,942	3,493	13,435
ZLO	MANZANILLO	6,196	2,333	8,529
SVL	MID	63,704	623	64,327
	TOTAL	**1,484,360**	**513,256**	**1,997,616**

Abreviaturas

IFR Reglas de Vuelo por Instrumento
VFR Reglas de Vuelo Visual
SVL Sobrevuelos Internacionales Centro de Control Mérida

VFR (Visual Flight Rules o Reglas de Vuelo Visual)
IFR (Instrumental Flight Rules o Reglas de Vuelo Instrumental)

ESTADÍSTICA OPERACIONAL POR ESTACIÓN

ENERO A DICIEMBRE DE 2014

ESTACION		IFR	VFR	TOTAL
ACA	ACAPULCO	20,081	12,785	32,866
ADN	AEROPUERTO DEL NORTE	27,779	21,553	49,332
AGU	AGUASCALIENTES	13,121	2,726	15,847
BJX	BAJIO (LEON)	24,811	3,326	28,137
CEN	CD. OBREGON	5,880	9,413	15,293
CJS	CD. JUAREZ	14,386	2,178	16,564
CME	CD. DEL CARMEN	8,211	52,417	60,628
COL	COLIMA	4,361	2,722	7,083
CPE	CAMPECHE	4,523	2,510	7,033
CSL	CABO SAN LUCAS	4,331	4,360	8,691
CTM	CHETUMAL	3,059	2,373	5,432
CUL	CULIACAN	21,097	24,554	45,651
CUN	CANCUN	138,811	7,022	145,833
CUU	CHIHUAHUA	21,208	11,121	32,329
CVA	CUERNAVACA	1,392	19,114	20,506
CVM	CD. VICTORIA	6,873	5,102	11,975
CZA	CHICHEN ITZA	40	558	598
CZM	COZUMEL	8,008	10,942	18,950
DGO	DURANGO	6,795	10,228	17,023
GDL	GUADALAJARA	109,938	22,091	132,029
GYM	GUAYMAS	662	5,882	6,544
HMO	HERMOSILLO	27,562	14,979	42,541
HUX	HUATULCO	6,142	1,901	8,043
LAP	LA PAZ	12,724	12,203	24,927
LMM	LOS MOCHIS	6,029	10,035	16,064
LTO	LORETO	2,036	3,889	5,925
MAM	MATAMOROS	9,397	5,504	14,901
MEX	MÉXICO	399,207	48,039	447,246
MID	MÉRIDA	24,260	5,695	29,955
MLM	MORELIA	10,396	8,087	18,483
MTT	MINATITLAN	5,516	3,231	8,747
MTY	MONTERREY	116,976	4,327	121,303
MXL	MEXICALI	6,797	5,300	12,097
MZT	MAZATLAN	26,568	10,611	37,179
NLD	NUEVO LAREDO	7,085	2,735	9,820
OAX	OAXACA	13,279	6,467	19,746
PAZ	POZA RICA	5,703	5,230	10,933
PBC	PUEBLA	9,475	16,283	25,758
PPE	PUERTO PEÑASCO	348	3,468	3,816
PQE	PALENQUE	586	863	1,449
PVR	PUERTO VALLARTA	37,362	6,147	43,509
PXM	PUERTO ESCONDIDO	3,396	4,258	7,654
QET	QUERETARO	20,829	13,812	34,641
REX	REYNOSA	20,215	10,706	30,921
SJD	SAN JOSE DEL CABO	35,896	1,379	37,275
SLP	SAN LUIS POTOSI	18,198	4,996	23,194
TAM	TAMPICO	15,521	7,251	22,772
TAP	TAPACHULA	4,837	5,028	9,865
TGZ	TUXTLA GUTIERREZ	13,211	6,217	19,428
TIJ	TIJUANA	41,295	4,827	46,122
TLC	TOLUCA	70,279	19,691	89,970
TNY	TEPIC	3,579	3,857	7,436
TRC	TORREON	13,395	5,372	18,767
UPN	URUAPAN	1,304	6,585	7,889
VER	VERACRUZ	25,085	9,298	34,383
VSA	VILLAHERMOSA	20,283	5,829	26,112
ZCL	ZACATECAS	6,821	2,517	9,338
ZIH	ZIHUATANEJO	10,727	3,572	14,299
ZLO	MANZANILLO	6,209	2,306	8,515
SVL	MID	67,004	684	67,688
	TOTAL	1,570,899	526,156	2,097,055

Abreviaturas

IFR	Reglas de Vuelo por Instrumento
VFR	Reglas de Vuelo Visual
SVL	Sobrevuelos Internacionales Centro de Control Mérida

VFR (Visual Flight Rules o Reglas de Vuelo Visual)

IFR (Instrumental Flight Rules o Reglas de Vuelo Instrumentos)

ESTADÍSTICA OPERACIONAL POR ESTACIÓN

ENERO A DICIEMBRE DE 2015

ESTACION		IFR	VFR	TOTAL
ACA	ACAPULCO	21,157	10,380	31,537
ADN	AEROPUERTO DEL NORTE	26,061	19,661	45,722
AGU	AGUASCALIENTES	13,301	2,542	15,843
BJX	BAJIO (LEON)	29,497	3,587	33,084
CEN	CD. OBREGON	5,680	9,785	15,465
CJS	CD. JUAREZ	14,089	2,225	16,314
CME	CD. DEL CARMEN	9,083	44,551	53,634
COL	COLIMA	4,111	2,218	6,329
CPE	CAMPECHE	4,509	2,196	6,705
CSL	CABO SAN LUCAS	5,255	2,781	8,036
CTM	CHETUMAL	3,362	2,310	5,672
CUL	CULIACAN	20,460	19,810	40,270
CUN	CANCUN	153,949	7,960	161,909
CUU	CHIHUAHUA	22,608	10,916	33,524
CVA	CUERNAVACA	1,335	22,062	23,397
CVM	CD. VICTORIA	5,715	3,961	9,676
CZA	CHICHEN ITZA	32	548	580
CZM	COZUMEL	8,372	11,244	19,616
DGO	DURANGO	7,411	11,497	18,908
GDL	GUADALAJARA	113,358	22,143	135,501
GYM	GUAYMAS	777	4,976	5,753
HMO	HERMOSILLO	25,442	14,759	40,201
HUX	HUATULCO	6,807	1,709	8,516
LAP	LA PAZ	13,900	14,684	28,584
LMM	LOS MOCHIS	6,233	9,317	15,550
LTO	LORETO	1,894	3,191	5,085
MAM	MATAMOROS	8,345	5,860	14,205
MEX	MÉXICO	415,570	51,105	466,675
MID	MÉRIDA	25,842	4,999	30,841
MLM	MORELIA	10,446	8,210	18,656
MTT	MINATITLAN	5,168	2,483	7,651
MTY	MONTERREY	129,559	3,738	133,297
MXL	MEXICALI	7,465	4,688	12,153
MZT	MAZATLAN	27,426	9,527	36,953
NLD	NUEVO LAREDO	6,112	2,021	8,133
OAX	OAXACA	14,827	6,372	21,199
PAZ	POZA RICA	4,257	4,240	8,497
PBC	PUEBLA	10,444	17,527	27,971
PPE	PUERTO PEÑASCO	232	3,734	3,966
PQE	PALENQUE	432	795	1,227
PVR	PUERTO VALLARTA	41,264	5,292	46,556
PXM	PUERTO ESCONDIDO	3,482	3,730	7,212
QET	QUERETARO	22,457	15,353	37,810
REX	REYNOSA	18,171	7,983	26,154
SJD	SAN JOSE DEL CABO	38,523	799	39,322
SLP	SAN LUIS POTOSI	17,903	4,284	22,187
TAM	TAMPICO	15,429	7,144	22,573
TAP	TAPACHULA	4,849	5,228	10,077
TGZ	TUXTLA GUTIERREZ	13,865	5,856	19,721
TIJ	TIJUANA	44,768	5,271	50,039
TLC	TOLUCA	72,442	17,893	90,335
TNY	TEPIC	3,493	3,510	7,003
TRC	TORREON	13,487	4,895	18,382
UPN	URUAPAN	1,246	4,969	6,215
VER	VERACRUZ	23,578	7,471	31,049
VSA	VILLAHERMOSA	20,768	2,731	23,499
ZCL	ZACATECAS	6,782	2,498	9,280
ZIH	ZIHUATANEJO	11,314	2,987	14,301
ZLO	MANZANILLO	5,751	2,207	7,958
SVL	MID	69,751	1,049	70,800
	TOTAL	**1,639,846**	**497,462**	**2,137,308**

Abreviaturas	**IFR**	Reglas de Vuelo por Instrumento
	VFR	Reglas de Vuelo Visual
	SVL	Sobrevuelos Internacionales Centro de Control Mérida

VFR (Visual Flight Rules o Reglas de Vuelo Visual)

IFR (Instrumental Flight Rules o Reglas de Vuelo Instrumentos)

ESTADÍSTICA OPERACIONAL POR ESTACIÓN

ENERO A DICIEMBRE 2016

ESTACION		IFR	VFR	TOTAL
ACA	ACAPULCO	20,718	10,456	31,174
ADN	AEROPUERTO DEL NORTE	25,759	20,009	45,768
AGU	AGUASCALIENTES	14,033	2,633	16,666
BJX	BAJIO (LEON)	30,637	3,814	34,451
CEN	CD. OBREGON	6,350	9,826	16,176
CJS	CD. JUAREZ	17,760	3,609	21,369
CME	CD. DEL CARMEN	8,050	30,273	38,323
COL	COLIMA	4,346	2,306	6,652
CPE	CAMPECHE	4,269	2,188	6,457
CSL	CABO SAN LUCAS	6,502	3,222	9,724
CTM	CHETUMAL	3,323	2,274	5,597
CUL	CULIACAN	22,270	20,406	42,676
CUN	CANCUN	164,339	7,881	172,220
CUU	CHIHUAHUA	25,460	11,904	37,364
CVA	CUERNAVACA	2,203	26,958	29,161
CVM	CD. VICTORIA	5,765	4,102	9,867
CZA	CHICHEN ITZA	48	429	477
CZM	COZUMEL	8,528	10,460	18,988
DGO	DURANGO	8,698	10,873	19,571
GDL	GUADALAJARA	125,810	22,562	148,372
GYM	GUAYMAS	1,265	4,568	5,833
HMO	HERMOSILLO	28,168	14,229	42,397
HUX	HUATULCO	7,464	1,649	9,113
LAP	LA PAZ	17,112	9,967	27,079
LMM	LOS MOCHIS	8,045	9,850	17,895
LTO	LORETO	1,949	3,071	5,020
MAM	MATAMOROS	7,794	5,368	13,162
MEX	MÉXICO	437,078	52,498	489,576
MID	MÉRIDA	28,787	5,147	33,934
MLM	MORELIA	10,608	9,487	20,095
MTT	MINATITLAN	4,931	2,976	7,907
MTY	MONTERREY	132,895	3,921	136,816
MXL	MEXICALI	8,001	4,498	12,499
MZT	MAZATLAN	33,182	9,887	43,069
NLD	NUEVO LAREDO	6,008	2,300	8,308
OAX	OAXACA	16,535	6,620	23,155
PAZ	POZA RICA	3,043	3,159	6,202
PBC	PUEBLA	11,571	19,866	31,437
PPE	PUERTO PEÑASCO	470	3,665	4,135
PQE	PALENQUE	393	655	1,048
PVR	PUERTO VALLARTA	44,686	5,237	49,923
PXM	PUERTO ESCONDIDO	3,611	4,276	7,887
QET	QUERETARO	25,184	26,946	52,130
REX	REYNOSA	17,417	7,227	24,644
SJD	SAN JOSE DEL CABO	43,091	686	43,777
SLP	SAN LUIS POTOSI	19,135	5,207	24,342
TAM	TAMPICO	14,370	7,160	21,530
TAP	TAPACHULA	5,048	5,997	11,045
TGZ	TUXTLA GUTIERREZ	15,104	6,094	21,198
TIJ	TIJUANA	53,930	5,023	58,953
TLC	TOLUCA	76,264	20,920	97,184
TNY	TEPIC	4,636	4,332	8,968
TRC	TORREÓN	15,562	4,388	19,950
UPN	URUAPAN	1,261	4,639	5,900
VER	VERACRUZ	22,517	6,085	28,602
VSA	VILLAHERMOSA	20,012	2,615	22,627
ZCL	ZACATECAS	6,492	2,015	8,507
ZIH	ZIHUATANEJO	11,392	2,609	14,001
ZLO	MANZANILLO	5,945	2,314	8,259
SVL	MÉRIDA	76,966	1,094	78,060
	TOTAL	**1,752,790**	**504,430**	**2,257,220**

Abreviaturas

IFR	Reglas de Vuelo por Instrumento
VFR	Reglas de Vuelo Visual
SVL	Sobrevuelos Internacionales Centro de Control Mérida

VFR (Visual Flight Rules o Reglas de Vuelo Visual)

IFR (Instrumental Flight Rules o Reglas de Vuelo Instrumentos)

ESTADÍSTICA OPERACIONAL ESTIMADA 2017

Haciendo una extrapolación para el calculo estimado del número de operaciones en 2017 se tiene que:

Ops en 2016 : 1,675,824

Incremento de ops: 4.40 %

Realizando la sumatoria:

1,675,824 + 4.40 % = 1,749,638

Operaciones 2016	**1,675,824**
Incremento de operaciones	**4.40 %**
TOTAL	**1,749,638**

Fuente: https://www.gob.mx/seneam/acciones-y-programas/estadisticas-de-operaciones