

# Preliminary RVSM Cost/Benefit Analysis for Commercial Operators in the CAR/SAM

Fourth Meeting of the ATM  
Authorities and Planners

RVSM TF/4

Santa Cruz, Bolivia

FAA/CSSI, Inc.

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# CSSI, Inc. Cost-Benefit Experience

## U.S. FAA Rulemaking Package Support:

- PAC RVSM Regulatory Evaluation
- WATRS RVSM Regulatory Evaluation
- DRVSM Regulatory Impact Analysis

## Regional Pre-implementation Studies:

- South China Sea Cost Assessment
- Western Pacific/South of the Himalayas Cost Assessment
- MID Region RVSM Cost Assessment

# Cost Assessment Methodology

- Identify airspace users in the CAR/SAM
- Identify aircraft fleets of airspace users and their plans for RVSM compliance
  - Commercially available data source (BuchAir Database/J&P Airline Fleets)
- Determine capability of airspace users to comply with RVSM requirements
  - Aircraft approval status (source: FAA Technical Center (ACB-310) Unified NAT CMA/APARMO Approvals Database)

# Cost Assessment Methodology

- Costs and benefits evaluated for 15-year period and discounted for inflation at 7% per annum
- Costs associated with the implementation
  - Operator RVSM aircraft engineering costs
    - Determine equipment installation and upgrade costs
  - Determine CAA / ATC costs
    - System upgrade costs
    - Controller training
- Total cost = user costs + CAA costs

# Cost Assessment Assumptions

- Aircraft Engineering costs range from \$0-\$175,000.00 depending on type
- The non-approved airframes of the CAR/SAM commercial operator fleet will be upgraded for RVSM
- 50% of the total aircraft upgrade costs for the CAR/SAM will be borne in 2003 with the remaining 50% occurring in year 2004

# Aircraft Upgrade Costs by Type (\$USD)

CAR/SAM COMMERCIAL AIRCRAFT RVSM UPGRADE COSTS					
TYPE	ESTIMATED COST	SOURCE OF ESTIMATE	TYPE	ESTIMATED COST	SOURCE OF ESTIMATE
A30B	****	Manufacturer (Visual inspection only)	B762	****	Manufacturer (Visual inspection only)
A310	****	Manufacturer (Visual inspection only)	B763	****	Manufacturer (Visual inspection only)
A319	****	Manufacturer (Visual inspection only)	B772	****	Manufacturer (Visual inspection only)
A320	****	Manufacturer (Visual inspection only)	CRJ1	****	Manufacturer
A321	****	Manufacturer (Visual inspection only)	CRJ2	****	Manufacturer
A332	****	Manufacturer (Visual inspection only)	DC10	\$2,200.00	OWG Survey 6/97
A342	****	Manufacturer (Visual inspection only)	DC8	\$150,000.00	Engineering design organization
A343	****	Manufacturer (Visual inspection only)	DC9	\$150,000.00	Engineering design organization
A346	****	Manufacturer (Visual inspection only)	E135	\$17,500.00	Manufacturer
B703	\$175,000.00	Engineering design organization	E145	\$17,500.00	Manufacturer
B721	\$130,000.00	Engineering design organization	F100	\$8,000.00	Operator Survey 6/01
B722	\$130,000.00	Engineering design organization	F28	\$50,000.00	Engineering analysis
B731	\$130,000.00	Engineering design organization	IL62	\$150,000.00	Engineering analysis
B732	\$130,000.00	Engineering design organization	IL76	\$150,000.00	Engineering analysis
B733	\$17,500.00	Operator Survey 1/01	J328	****	Manufacturer
B734	\$17,500.00	Manufacturer (Visual inspection only)	JCOM	\$150,000.00	Engineering design organization
B735	\$17,500.00	Manufacturer (Visual inspection only)	L101	\$25,000.00	Manufacturer, 1/01
B737	****	Manufacturer (Visual inspection only)	MD11	\$2,200.00	Engineering analysis
B738	****	Manufacturer (Visual inspection only)	MD80	\$33,300.00	Engineering analysis
B742	\$58,400.00	FAA Survey 12/97 and OWG Survey 6/97	YK40	\$150,000.00	Engineering analysis
B752	\$50,700.00	FAA Survey 12/97 and OWG Survey 6/97	YK42	\$150,000.00	Engineering analysis

# CAR/SAM Upgrade Cost Summary for Commercial Aircraft

CAR/SAM FLEET UPGRADE COST ESTIMATE				
CATEGORY	FLEET	APPROVED	TO APPROVE	TOTAL COST
COM	1,265	94	1,171	\$ 78,037,500.00

# CAR/SAM Upgrade Cost Summary for Commercial Aircraft for Years 2003-4

COMMERCIAL AIRCRAFT RVSM UPGRADE COSTS				
YEAR	YEARLY UPGRADE COSTS	TOTAL COST	DISCOUNT RATE FACTOR	DISCOUNTED TOTAL
2003	\$39,018,750.00	\$39,018,750.00	0.9346	\$ 36,466,923.75
2004	\$39,018,750.00	\$39,018,750.00	0.8734	\$ 34,078,976.25
TOTAL	\$78,037,500.00	\$78,037,500.00		\$ 70,545,900.00

# Fuel-burn Modeling Methodology

- Modeling was conducted by adapting models developed for NICE U.S.A by FAA ACB-310 and Rutgers University
- One-week traffic sample of OAG data for 16-22 September 2002 was used for fuel-burn modeling
- Cumulative distributions were created for the aircraft types, mach number, take-off weights
- Fuel-burn modeling was conducted by generating a baseline of actual events for CVSM and simulating the flight plans in an RVSM environment

# Fuel-burn Modeling Methodology

- Flights were modeled using route information provided by the IATA Miami Office
- ETMS data supplemented the modeling to create a ranking of routes flown between city pairs with remaining city pairs modeled using direct routings
- FAA forecasted fuel cost of \$USD .67 per gallon was used
- Benefits were inflated at 3.8% per annum in proportion to the projected annual growth rate for total operations in the CAR/SAM (source: IATA Miami Office)

# CAR/SAM Fuel-burn Modeling Summary

- Average CAR/SAM fuel savings was determined to be 104.43 lbs. per flight
- Average fuel savings of RVSM vs. CVSM is 1.63%
- Yearly fuel savings calculated to be \$USD 30.4 million

# 15-year CAR/SAM RVSM Fuel Savings

<b>CAR/SAM COMMERCIAL AIRCRAFT FUEL SAVINGS</b>			
<b>YEAR</b>	<b>SAVINGS</b>	<b>FACTOR</b>	<b>DISCOUNTED</b>
2003	\$ -	0.9346	\$ -
2004	\$ -	0.8734	\$ -
2005	\$ 32,767,375.18	0.8163	\$28,619,025.49
2006	\$ 34,012,535.44	0.7629	\$27,764,432.68
2007	\$ 35,305,011.79	0.713	\$26,934,193.49
2008	\$ 36,646,602.24	0.6663	\$26,129,027.39
2009	\$ 38,039,173.12	0.6227	\$25,345,501.05
2010	\$ 39,484,661.70	0.582	\$24,587,098.84
2011	\$ 40,985,078.84	0.5439	\$23,853,315.89
2012	\$ 42,542,511.84	0.5083	\$23,138,872.19
2013	\$ 44,159,127.29	0.4751	\$22,446,084.40
2014	\$ 45,837,174.13	0.444	\$21,777,241.43
2015	\$ 47,578,986.74	0.415	\$21,125,070.11
2016	\$ 49,386,988.24	0.3878	\$20,495,600.12
2017	\$ 51,263,693.79	0.3624	\$19,880,060.45
<b>TOTAL</b>	<b>\$ 538,008,920.35</b>		<b>\$312,095,523.54</b>

# CAR/SAM Cost-Benefit Ratio

<b>CAR/SAM RVSM COST BENEFIT ANALYSIS</b>		
<b>ITEM</b>	<b>TOTAL</b>	<b>DISCOUNTED TOTAL</b>
<b>UPGRADE COSTS</b>	\$ 78,037,500.00	\$ 70,545,900.00
<b>15-YR SAVINGS</b>	\$ 538,008,920.35	\$312,095,523.54
<b>COST/BENEFIT RATIO</b>	<b>6.89</b>	<b>4.42</b>

# Comparison of RVSM Cost-Benefit Ratios

RVSM Costs and Benefits						
Initiative	Cost	Benefit	Ratio	Disc. Cost	Disc. Benefit	Ratio
PAC	\$ 21,700,000.00	\$ 120,000,000.00	5.53	\$ 19,500,000.00	\$ 83,800,000.00	4.30
WATRS	\$ 26,200,000.00	\$ 34,200,000.00	1.31	\$ 23,400,000.00	\$ 18,400,000.00	0.79
CAR/SAM	\$ 78,037,500.00	\$ 538,008,920.35	6.89	\$ 70,545,900.00	\$ 312,095,523.54	4.42
DRVSM	\$ 866,500,000.00	\$ 4,900,000,000.00	5.65	\$ 762,800,000.00	\$ 3,000,000,000.00	3.93

# Future Plans and Considerations

- Complete analysis to be presented in a working paper at next Task Force meeting
- A stratified traffic sample would account for seasonal variation and peak traffic periods to increase the accuracy of this study
- FIR traffic samples to support “Know Your Airspace” analysis for CAR/SAM and determine total costs and benefits for all airspace users
- Airborne and ground delay benefits should result from RVSM