

April 2010

AEROSPACE

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20

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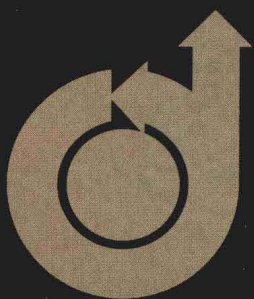
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Authors of appropriate papers are encouraged to submit them for possible publication in one of the Institute's archival journals: *AIAA Journal*; *Journal of Aircraft*; *Journal of Guidance, Control, and Dynamics*; *Journal of Propulsion and Power*; *Journal of Spacecraft and Rockets*; *Journal of Thermophysics and Heat Transfer*; or *Journal of Aerospace Computing, Information, and Communication*. WriteTrack will be replaced by ScholarOne Manuscripts (Thomson Reuters) during 2009. More information about the transition is available on the WriteTrack home page.

Speakers' Briefing

Authors who are presenting papers, session chairs, and co-chairs will meet for a short briefing at 0700 hrs on the mornings of the conference. Continental breakfast will be provided. Please plan to attend only on the day of your session(s). Location will be in final program.

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A speaker practice room will be available for speakers wishing to practice their presentations. A sign-up sheet will be posted on the door for half-hour increments.

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Each paper will be allotted 30 minutes (including introduction and question-and-answer period) except where noted.

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Professionals registering at the nonmember rate will receive a one-year AIAA membership. Students who are not members may apply their registration fee toward their first year's student member dues.

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Smoking is not permitted in the technical sessions.

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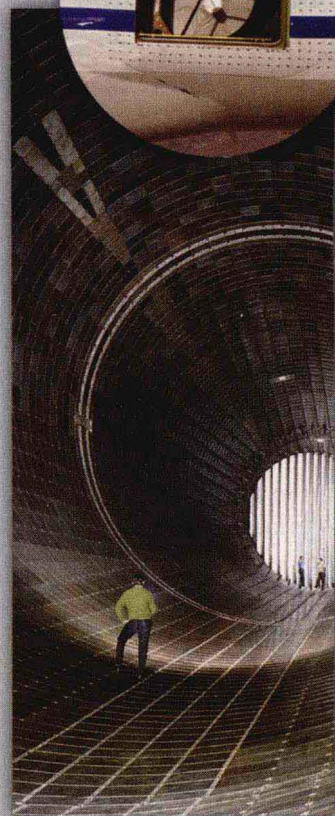


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American Institute of
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Editorial

Working toward compromise

When we were young, nothing thrilled us as much as shiny new toys. The newest bicycle in the store window made our trusty old one seem shabby and boring. Never mind that sometimes, when we got it home, we found that it was too difficult to pedal, or we would fall down all the time, or that our parents couldn't really afford it. It was new and we wanted it.

The space shuttle is getting old, and after having served us well for so long, many believe it is just about ready for a well-deserved retirement. Constellation, on the other hand, was big, and shiny, and new...but our government really doesn't seem to be able to afford it, and, even if it someday lives up to its billing, like most other government programs, it would probably take far longer and cost far more than predicted to get there.

The Obama administration has ordered the cancellation of the entire Constellation program, turning instead to private industry to lead us back into space. As these companies work toward development of rockets and crew carriers, the government would purchase rides to the space station on Russian Soyuz launch vehicles.

Many legislators oppose this approach, as it represents lost jobs, a waste of the billions of dollars already spent on Constellation, and a massive flow of new dollars out of the country. They argue that work should continue on Constellation, to protect jobs and maintain U.S. access to space. However, the Augustine Commission has already established that this program will cost far more—and take far longer to complete—than first anticipated.

But in the search for a replacement system for the space shuttle, did we overlook maybe not the newest, but certainly one of the most reliable options? The evolved expendable launch vehicles built for the Air Force, Lockheed Martin's Atlas V and Boeing's Delta IV, have outstanding safety records. Is there not some possibility of taking some of the funding that had been allocated to Constellation's Ares I rocket and using it to human-rate these launch vehicles?

Rather than shutting down the Orion crew exploration vehicle, could work not continue, while reconfiguring it to be accommodated by one of the EELVs? Could work also continue on the launch abort system, to make sure that we add another layer of safety for its precious cargo?

And while these developments proceed, could we not ask the venerable shuttles to take just a few more trips into space before finding homes in museums and space parks? Restarting assembly of the external tanks would also restart some lost jobs.

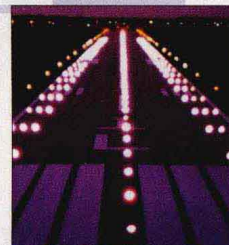
In the interim, private industry can continue to build, test, fly—crash—and fly again, until they get it right.

It might not save all the jobs that would be lost by termination of Constellation, but it should save many. And we might still have to hitch a ride now and again from Russia, but not every time.

As we get a little older, we start to realize that shiny and new really isn't what matters. Solid and dependable trumps it every time.

Elaine Camhi

Editor-in-Chief



Europe tackles runway capacity issue

ONE OF THE TOUGHEST CHALLENGES OF the Single European Sky ATM Research (SESAR) program is the doubling or trebling of airspace capacity by 2025 over 2005. In the three dimensions of European airspace this is tough, but feasible. In the two dimensions of the runways at Europe's major airport hubs, the goal of trebling capacity looks virtually impossible; for environmental reasons it will simply not be practical to build new runways to cope with future demand.

But if this issue is not addressed, then the entire \$30-billion SESAR program is threatened—without enough runway capacity, all SESAR will do is move increasing amounts of air traffic more swiftly between the bottlenecks on the ground.

So Europe's air traffic management (ATM) experts are contemplating some radical technologies and procedures to ensure that airports do not become the bottlenecks to future growth.

Surprising differences

There are some startling differences between the current runway throughput rates of Europe's largest airports. It would be tempting, looking at these figures, to say the simple answer to the runway congestion problem is to analyze how London/Heathrow traffic is managed and then replicate this elsewhere. Heathrow's ability to manage 89 aircraft movements an hour off two runways is even more remarkable considering the high percentage of larger (and therefore slower and more widely spaced) planes

using the airport. The number of aircraft movements at Heathrow is closely comparable to those at Detroit Metropolitan Wayne County Airport, but Detroit has six runways, and the aircraft that use it are much smaller, on average, than those at Heathrow.

But every airport is different; the environmental and curfew constraints and the airport runway and taxiway layout make accurate comparisons nearly impossible. Heathrow's runway performance levels have been realized through a mixture of applying new technology, refining procedures and, increasingly, collaborative decision-making (CDM) tools designed to involve all stakeholders in maximizing runway efficiencies.

"We had the target at Heathrow of achieving an average of less than 50 seconds' occupancy time across a wide range of aircraft," says Peter Tomlinson, airport technical expert at the U.K.'s NATS (National Air Traffic Services), which oversees the ATM system at the airport. "One of the ways we looked to reach this target was to identify who was the 'best-in-class' among the aircraft operators using a particular aircraft type and then try to replicate that airline's procedures across the board. It is surprising how different the procedures are for the same aircraft—when the checklists are completed, for example—and this can have a major difference on runway and taxiway occupancy times."

Using the best-practice model has been a core element of Eurocontrol's airport airside capacity enhancement (ACE)

program, which has helped increase capacity at Lisbon and Prague airports by factors of 20% and 40% respectively, according to Eric Miart, program manager of the airport operations program at Eurocontrol. ACE relies on taking accurate measurements of the performance of the airport operation, assessing capacity and introducing best practice techniques to controllers, pilots and airport operators.

Improving traffic flow and safety

The tools for increasing runway capacity levels have been in place for some time. Apart from building rapid exit taxiways and other taxiways running parallel to the main runway, some new technologies coming into operation offer substantial improvements on legacy systems.

For example, A-SMGCS (advanced surface movement guidance and control systems)—which provide routing, guidance and surveillance to aircraft under all weather conditions—have been in operation since the early years of the decade. Precision Runway Monitoring-Alternative (PRM-A) is an accurate multilateration surveillance system that gives the precise aircraft position information needed to simultaneously separate planes on approach into closely spaced parallel runways. And light detection and ranging (LiDAR) systems measure the Doppler shift of light scattered from atmospheric particles to identify wake vortex occurrences and separate aircraft on approach based on actual, rather than theoretical, wake vortex occurrences.

But if a 300% increase in airport ca-

Airport	Runways	Aircraft movements	Reporting period	Average daily movements per runway
Paris Charles de Gaulle	4	518,018	January–December 2009	354.8
London Heathrow	2	462,835	October 2008–September 2009	634.0
Frankfurt	3	463,111	January–December 2009	422.9
Madrid	4	435,179	January–December 2009	298.0
Amsterdam/Schiphol	5	391,000	January–December 2009	214.2

News
Aerospace

capacity is to be achieved without trebling the number of runways and taxiways, an entirely new way of managing airport operations will be needed. Already under way in Europe is research on developing a network-enabled information system that will link new ground-based and airborne technologies along with best-in-class procedures for radically enhancing airport capacity levels. Ultimately the goal will be to automate the entire runway/taxiway operation, ensuring that both are being used to their optimal capacity, whatever the weather, and without degrading the required safety levels.

"Whatever the improvements, safety has to be improved, and especially the prevention of runway incursions," says Eric Miart. "Risk increases as a square of the increase in traffic; if traffic doubles or triples, then risk increases by a factor of four or nine respectively."

Network enhancement

In Europe the catalyst to the development of a common information network encompassing pilots, controllers and airport operations managers is the European Airport CDM (www.euro-cdm.org) program promoted by Eurocontrol, Airports Council International Europe and the International Air Transport Association. The largest weakness in the current European ATM capacity management system is a lack of coordination between airports and ATM network managers.

The Central Flow Management Unit, based in Eurocontrol's Brussels headquarters, operates a continental flow management system by matching aircraft operator flight plans with the available capacity of airspace sectors and airport runways. It forecasts where potential sectors may become overloaded and calculates alternative operations—such as delaying takeoff times or rerouting aircraft in flight—to keep supply and demand in balance.

One of the major current weaknesses in the system is a lack of accurate information on actual airport operations—the time the aircraft pushes back from the terminal, its progress through the airport taxiway system and the time when it rolls onto the runway for takeoff. The key

piece of information here is the Target Start Up Approval Time (TSAT), which lets ATC, airport and airline colleagues know exactly when the aircraft is ready to move from the terminal. By feeding this information into a central planning tool it will be possible to calculate accurately whether the aircraft will meet the takeoff slot-time it has been given—and, if not, how traffic can best be managed to accommodate changes to slot times.

NATS has been testing a version of what it calls a TSAT-generator. "Once we know when the aircraft will be ready to move, we can project the taxiing time, look at how this would work in an unconstrained demand situation, then feed in the various variables," according to Tomlinson. "We can calculate the optimum sequence and then work out exactly what time the aircraft needs to leave the gate. We think this will give us an extra two departures an hour while reducing the amount of time the aircraft waits at the gate by 50% and taxi times by 6 minutes."

It seems like a modest improvement, but the development of a CDM information network linking the cockpit, the

control tower and the airport will provide the essential framework to a new runway and operations management system. The network needs to evolve from a planning tool to an operational system; but once this is done, increasing levels of automation can be introduced.

For example, A-SMGCS systems are now used mainly to improve surveillance of aircraft and ground vehicles at airports in bad weather. However, ultimately (defined as "level four" operations) they can evolve to provide automatic conflict resolution and automatic planning and guidance for pilots and controllers. The FAA, Eurocontrol and ICAO are working on developing standards and procedures for these levels of operation.

Airborne additions

New airborne technologies will need to be added to the information network. For example, the FAA is funding research into how electronic flight bags can be evolved to show airport moving map displays and own-ship positions, so pilots can see the exact location of their aircraft on the airfield. But in the future, the networks will have to be developed



Aircraft queue for takeoff at Heathrow.

to incorporate new automated airborne systems.

For example, the Airbus A380 features an automated "brake-to-vacate" facility that combines satellite positioning with the on-board airport database and flight-control management system. The pilot selects a runway exit point and the system manages the braking process to ensure the aircraft reaches the chosen exit point at the optimal speed, having factored in runway and weather conditions. According to Airbus, the system minimizes runway occupancy time and allows up to 15% more departures to be scheduled.

The European Commission is also helping to fund a research program called "Green-wake," where an airborne LiDAR alerts pilots to wake vortex and wind shear occurrences on final approach. This is part of the wider WakeNet3 (www.wakenet3-europe.eu) commission-funded research program (2008-11) that examines how crosswinds, wind shear and wake vortex conditions can be measured, reported and acted upon promptly.

Looking ahead

Other, more esoteric planning and operational tools are waiting in the wings. "NATS is working with the McLaren Formula One racing team, using race team prediction software and putting this into an airport environment," according to Tomlinson. "It allows us to predict the future of airport operations with a high degree of accuracy over half-hour, 1-hr and 2-hr time slots. We can then color-code the areas of the airport where we see potential capacity problems arising."

At the moment, at least, the airport and runway capacity problem has abated because of the recent downturn in the air travel market. But growth will return, probably later this year, and with it the pressure on Europe's hub runways will reemerge.

If the future anticipated traffic levels are to be met then without the appearance of five new runways at Europe's major hubs, the development of network-enabled airport CDM operations is more than just a helpful aid to improving capacity. It is an empirical necessity.

Philip Butterworth-Hayes
phayes@mistral.co.uk

Events Calendar

APRIL 12-15

Fifty-first AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference; 18th AIAA/ASME/AHS Adaptive Structures Conference; 12th AIAA Nondeterministic Approaches Conference; 11th AIAA Gossamer Systems Forum; Sixth AIAA Multidisciplinary Design Optimization Specialist Conference, Orlando, Fla.

Contact: 703.264.7500

APRIL 12-15

Twenty-sixth National Space Symposium, Colorado Springs, Colo.

Contact: 719.660.6380

APRIL 20-22

AIAA Infotech@Aerospace 2010, Atlanta, Ga.

Contact: 703.264.7500

APRIL 25-30

SpaceOps 2010 Conference: Delivering on the Dream (hosted by NASA Marshall and organized by AIAA), Huntsville, Ala.

Contact: 703.264.7500

MAY 4-6

ASTRO 2010—15th CASI Astronautics Conference, Toronto, Ontario, Canada.

Contact: G. Languedoc, 613.591.8787; www.casi.ca

MAY 11-12

Inside Aerospace—An International Forum for Aviation and Space Leaders, Arlington, Va.

Contact: 703/264-7500

MAY 11-13

Integrated Communications, Navigation and Surveillance Conference, Herndon, Va.

Contact: James Dieudonne, 703/983-6578, jdieudon@mitre.org

MAY 13-15

Fifth Argentine Congress on Space Technology, Mar del Plata, Argentina.

Contact: Pablo de Leon, 701/777-2369; Deleon@aate.org

MAY 31-JUNE 2

Seventeenth St. Petersburg International Conference on Integrated Navigation Systems, St. Petersburg, Russia.

Contact: Prof. V. Peshekhonov, www.elektropribor.spb.ru

JUNE 1-4

Fourth International Conference on Research in Air Transportation, Budapest, Hungary.

Contact: Andres Zellweger, dres.z@comcast.net

JUNE 7-9

Sixteenth AIAA/CEAS Aeroacoustics Conference, Stockholm, Sweden.

Contact: Hans Bodén, hansbod@kth.se

JUNE 8-10

Third International Symposium on System and Control in Aeronautics and Astronautics, Harbin, People's Republic of China.

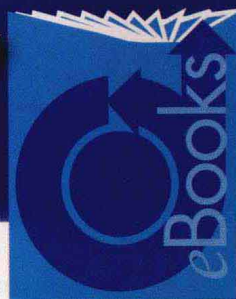
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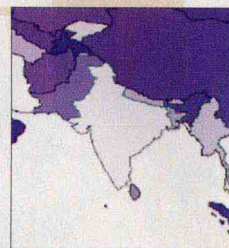
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India joins the race



THERE IS NO WAY THE AEROSPACE AND defense manufacturers of India (or any other nation) can hope to leap into direct competition with industry titans such as Boeing or EADS. Even joining the second tier with companies such as Brazil's Embraer and Canada's Bombardier is difficult enough, with China's AVIC (Aviation Industries of China) and Japan's Mitsubishi now just reaching that level after many years of effort and frustration.

Nevertheless, India's developments in spaceflight—including its January announcement of plans for a manned mission in 2016—are the harbinger of renewed efforts to match its giant neighbor China's surge into the international arena in aerospace technology. The question now is whether it can step up to the plate in attracting foreign investment, partners, and new technology to propel it into the top ranks.

The X-factor

In theory, there seems no good reason why India should not have been able to parallel China's steps up the technology ladder over the years. Both took on license production of military and civil aircraft types at various times, and both have—at least in principle—huge domestic markets to develop that could underpin the production of passenger aircraft locally.

In practice, their separate paths of economic development and their reliance on Western or former Soviet allies for access to training and technology have led to very different mindsets, and hence to very different approaches to acquiring and applying expertise.

It is not merely a matter of technical or scientific knowledge and ability; both approaches embody these factors. Nor is it a matter of industrial capacity; again, both China and India are perfectly capable of churning out different kinds of high-tech "widgets" or other gadgets.

But being able to produce reliably, even monotonously, complex items that

themselves involve the integration of complex components and systems, and then to sell and support those products in the world marketplace, needs something else—call it the X-factor if you will. It is something that has been learned over many years by the U.S. and Europe, and later by Canada and Brazil.

Japan with its regional jet project will have to show that it has learned it, having tried with other aviation projects that, no matter how technically excellent they were, failed to impress markets beyond its shores. Russia, too, is now seeking to win the world's confidence—its military products are well known for their capabilities, but its civil airliners have not won admiration beyond a very limited group of customers, and so Russian aerospace makers are also seeking to upgrade their products' reputations.

Avenues to progress

This leaves China and India at the back of the queue, still partnering or seeking to partner with foreign manufacturers, but trying to gain work shares that involve more than just being "screwdriver" operations, simply assembling aircraft or components from kits or supplied drawings. In this regard, China is further ahead than India; both have assembled foreign-designed military aircraft (MiGs and Sukhoi designs in both countries, British Aerospace Hawks and Sepecat Jaguars in India). Both have assembled foreign-designed airliners in the past—various Antonov fixed-wing models and MD80 twinjets (though a very limited number of the latter) in China, and small British HS748 turboprop airliners in India. Both have also put together various Russian and Western helicopters in series production.

But China took the lead in the 1980s with manufacturing major components for U.S. and European aircraft makers. It is now reaping the reward by partnering with Europe's Airbus to produce A320 airliners on a new production line set up

in Harbin. It is also renewing attempts, first made in the 1970s, at developing its own regional and larger jet airliners, this time buying modern foreign systems as it deems necessary and learning to integrate them into its own state-of-the-art overall design.

Both nations have made progress toward high-grade production via manufacturing automobiles, partnering with foreign makers. While India is now the world's fourth-largest exporter of cars after the U.S., Japan and South Korea, China has gone further and faster down this road in terms of new technology. India now needs something similar as a way of driving its technology base forward and broadening it from its acknowledged information technology and software-based excellence, building on its strengths: a pool of skilled engineering talent, and low costs.

A new approach

New Delhi's latest approach to attracting foreign interest into its aerospace and defense industries is to encourage its own private companies to take part. Until 2001, aerospace and defense were the preserve of public sector units controlled by the government, the largest of which was the government-controlled Hindustan Aeronautics Ltd. (HAL)—the 600-lb gorilla in the room, with the finance, the expertise and the industrial "magnetism" to attract the best talent.

Since then, private investment has been allowed, combined with a defense offset policy introduced in 2006 and followed up by significant liberalization in 2008.

The result should be a win-win situation for all concerned—the government is happy to give tax breaks to attract foreign investors with new technology and expand the country's high-tech manufacturing base, while foreign companies are happy to be able to seek alternatives to HAL, thus enlarging their pool of partnership options.

The government has also been encouraging the establishment of aerospace parks and special economic zones with tax advantages (so far seven have been formally proposed), all in India's southern or midcountry sectors. This approach should come as no great surprise, given that India's high-tech industries were originally clustered around Bangalore, where the old airport is owned by HAL.

There is no shortage of potential takers, although HAL is going to continue to be a big winner. The current contest to pick India's next major fighter aircraft illustrates the point: The so-called medium multirole combat aircraft contest features six types from four continents for a projected buy of 126 units, of which only 18 will be built overseas, with the remaining 108 manufactured under license by HAL.

In contention are the Lockheed Martin F-16 and Boeing F/A-18 from the U.S., Saab's Gripen from Sweden, Russia's MiG-35, France's Dassault Rafale and European consortium Eurofighter's Typhoon. A decision is expected later

this year.

The government had also tasked HAL with designing and building more than 180 light utility helicopters for its military forces. But this project has now morphed into somewhat smaller and more complex chunks, with Europe's Eurocopter saying it is bidding to supply (whether complete or license-built in India was not stated) about 90 aircraft, with U.S. maker Sikorsky also a contender for this deal. Meanwhile, Anglo-Italian helicopter maker AgustaWestland is seeking a joint venture with India's giant conglomerate Tata Group to produce light helicopters for the Indian military as well as for export. Tata has been seeking permission to build an aerospace manufacturing plant near Hyderabad in southern India's Andhra Pradesh state.

Other linkages include a defense electronics joint venture between EADS and Mumbai engineering giant Larsen & Toubro, as well as between L&T and Boeing and L&T with Raytheon. In terms of aircraft production, major Indian motorcycle maker Hero Motors is seeking to

build light aircraft in a special aerospace section in central Madhya Pradesh. Also, Indian car maker Mahindra & Mahindra has had several agreements with foreign high-tech companies, including Britain's BAE Systems, but it has a partnership with India's state aerospace research company, National Aerospace Laboratories, to produce a light aircraft with 2-18 seats. NAL is to develop and certify the aircraft for domestic use, while Mahindra Aerospace (a subsidiary of Mahindra & Mahindra) is to seek certification abroad and take charge of serial production.

Surprising gains

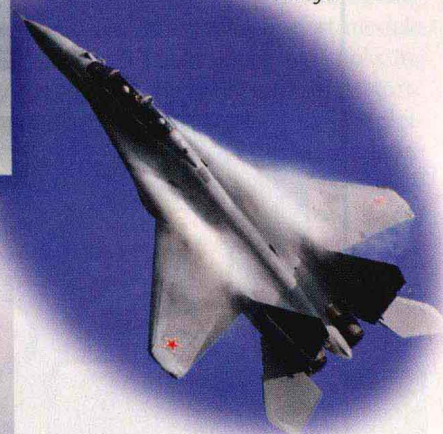
While to many people in India all of this probably seems—and indeed is—very much state of the art, to most observers outside the country it seems pretty small beer. Its significance is not so much what has been achieved so far, but that it is happening at all. For example, HAL has been discussing plans to build a 70-90-seat regional jet for several years, but so far nothing has resulted. India's government bureaucracy has a well-earned rep-



Dassault Rafale



Eurofighter Typhoon



Mikoyan MiG-35



Saab Gripen



Lockheed Martin F-16



Boeing F/A-18

These aircraft are in contention to become India's next major fighter, with most units to be built by HAL.

utation for stifling initiative, so the recent and current wave of liberalization is surprising for the gains it has made to date.

Even government-controlled entities have benefitted, with HAL, for instance, being among a relative handful of such companies to be granted so-called Navaratna status, allowing it considerable commercial freedom in such matters as setting up joint ventures with private companies. As HAL officials note, HAL has actually been responsible to a considerable extent for building up high-tech expertise in the private sector by subcontracting work that it did not have sufficient capacity to complete on its own.

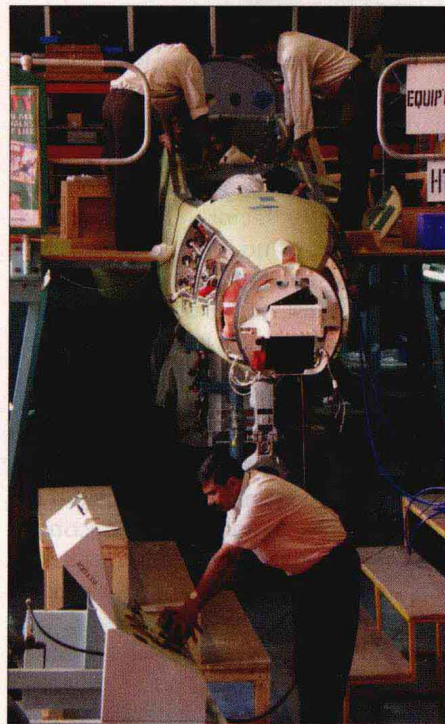
Constraints and barriers

Last year, accounting and corporate research giant PricewaterhouseCoopers issued a study on Indian defense and aerospace industry and investment opportunities; it pointed out that the limit of 26% on foreign ownership might restrict investors' enthusiasm for joint ventures, though it added that this limit might give Indian companies more leverage in negotiations. In practice, Indian

companies have echoed the opinion that the 26% limit needs to be overtaken with something more like 49%, based on the premise that technology transfers need to be well rewarded if they are to be real and not just disguised attempts at exploiting cheap labor in India.

Tata is probably the only Indian company other than HAL that could make serious inroads into manufacturing aircraft, not just because of its size but because of its background in aviation—the national carrier, Air India, was originally a division of the Tata Group. But going via the civil rather than military route is made more difficult by taxation; a foreign sale to the Ministry of Defense is exempt from tax, while spare parts for airliners are subject to import duty. This is currently a barrier to India promoting itself as a major center for maintenance, repair and overhaul—another avenue that can lead to significant technology transfers and training.

The PricewaterhouseCoopers study also looks at whether India can emulate China's sprint toward aerospace eminence, but comes to no real conclusion,



BAE Hawks for the Indian air force are built at HAL production line in Bangalore. Photo by Ajai Shukla.

except to say: "The fragmented nature of the Indian aerospace sector has been a hindrance in India achieving self-reliance in its aerospace capabilities." It points out that China has made a concerted effort to acquire technology from outside via joint ventures as well as developing its own resources, and has deliberately focused on building capabilities of all kinds.


"China also centralized its aerospace activities under one ministry at the government level; the majority of orders from its government drove economies of scale and encouraged exports," the study says. But in India, "With so many authorities as stakeholders in the development of this sector, there is no single national aeronautical policy or plan that has emerged to focus on industry's growth and self-reliance."

India's recent liberalizations of defense and aerospace investment are therefore a hugely welcome breath of fresh air. But win-win or not, it is going to need time to generate an Indian equivalent of Embraer or Bombardier. The learning process takes literally years.

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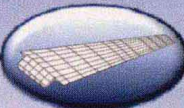
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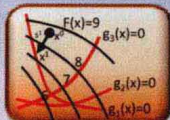
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Season for endings?

THE OBAMA ADMINISTRATION SAYS IT IS killing the Constellation human space-flight effort. The program was meant to provide a next-generation replacement for the familiar shuttle, which is being retired this year. Now the administration wants to partner with the private sector to develop what NASA Administrator Charles Bolden calls "quicker, cheaper, homegrown capacity to put astronauts into orbit."

Major shift for NASA

President Barack Obama has not made a public statement about his space policy even though the shift from Constellation to commercialization is the biggest change for NASA since the agency was created 52 years ago. Bolden, however, has made repeated trips to Capitol Hill to defend the policy.

The administration's FY11 budget proposal calls for the space agency to outsource rocket development for human spaceflight to commercial companies. This shift ends any immediate prospect of travel to the Moon or Mars and terminates the Ares I booster and the Orion crew exploration vehicle.

It is unclear whether the new policy can survive the scrutiny by Capitol Hill space proponents like Sen. Bill Nelson (D-Fla.) and Sen. Barbara Mikulski (D-Md.). In hearings at the end of February, senators and outside experts including NASA Advisory Council member Miles O'Brien criticized NASA for no longer having a destination. Bolden said the space agency still hopes to go to Mars but acknowledged that the current plan does not take U.S. astronauts to any specific place. Sen. David Vitter (R-La.) said the outsourcing plan is a "waste of money" without a goal. One congressional staffer said NASA has a "nebulous" sense of direction.

Bolden told Congress that his agency is making preparations to dismantle the Constellation program, even though some lawmakers say he needs their per-

mission to do so. Among those legislators are Rep. Pete Olson (R-Texas), 19 other Republicans and four Democrats, who wrote to Bolden citing a provision included in a 2010 omnibus spending bill that bars NASA from terminating any part of the space shuttle replacement effort without formal congressional approval. Bolden sent a letter in response to this claim that NASA is breaking the law, saying that he and the White House will fight any Capitol Hill opposition to the administration's proposed budget.

Some point out that the aerospace industry has not yet tested or flown a private sector, crewed vehicle that can assure sustained flights in LEO and service the ISS, which is the essential short-term goal for U.S. human spaceflight.

One bidder for a private sector role in space is Elon Musk's company, SpaceX, which wants to launch astronauts on its Falcon 9 rocket. "SpaceX is out to prove that a commercial approach will work," says Jeffrey Johnson, an analyst on space issues at Binghamton University in New York. But although the first Falcon 9 was being prepared for a test launch at press time, critics were asking whether any private company can complete a crewed vehicle that meets reliability, safety and cost specifications by 2013, the date promised by SpaceX. Said one spaceflight veteran, "If this gambit fails, we have no Plan B and no access to the International Space Station except by renting space on Russian Soyuz vehicles."

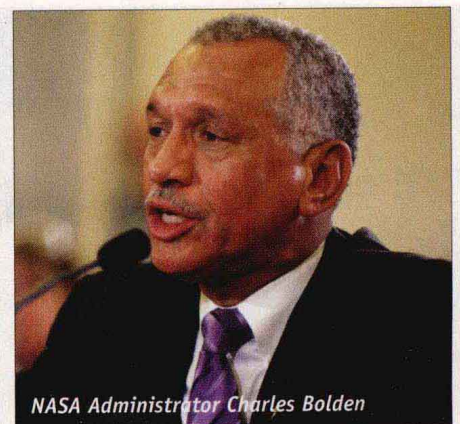
Support for the White House plan came from an unexpected quarter: Former Speaker of the House Newt Gingrich and former Science and Technology Committee Chairman Robert Walker opined in *The Washington Post* that the administration's plan "deserves strong approval from Republicans" because "it does what is obvious to anyone who cares about man's future in space and what presidential commissions have been

recommending for nearly a decade."

Even though NASA will receive more money in FY11 than in FY10, the agency will cut some jobs and assess the "role and size" of its astronaut corps—suggesting that some of the most recently named astronauts may never get to fly in space. One Washington observer estimated that termination of Constellation's Ares I booster and Orion crew capsule will "put 20,000 engineers out on the streets." The end of shuttle flights will cost about 7,000 jobs in the region around the Kennedy Spaceflight Center.

Just four shuttle missions remain on NASA's agenda following the February 21 landing of Endeavour and its six astronauts, commanded by Marine Corps Col. George D. Zamka, finishing the STS-130 mission that effectively completed construction of the ISS.

The mission boded well for relations between NASA and its European partners. STS-130 delivered the European-designed Tranquility life-support module along with a seven-window cupola intended for use by robot arm operators. One astronaut compared it to completing the final room of a house under construction. The space station is now 98% complete, with a pressurized volume of 28,947 ft³, nearly the same as the interior of a Boeing 747 widebody jetliner.



NASA Administrator Charles Bolden



STS-130 delivered the seven-window cupola to the space station, providing astronauts with a whole new perspective.

KC-X tanker program

On March 8 Northrop Grumman announced that it would not offer a bid in the Air Force's KC-X competition to build a new air refueling tanker. The move appears to open the way for rival Boeing to win a \$35 billion contract for 179 tankers based on the company's 767-200 widebody jetliner. The KC-X tanker would begin replacing the current fleet of about 450 Eisenhower-era KC-135R Stratotankers.

Northrop had been teamed with Airbus parent EADS to offer a version of the Airbus A330-200 to be manufactured in a new assembly plant in Birmingham, Alabama. Boeing will assemble its tankers in Everett, Washington, and fit them out in Wichita, Kansas. Northrop also announced that it would not

protest any award to Boeing, while EADS said it would not offer a tanker independently of its U.S. prime contractor.

Many analysts believe that either aircraft could do the job but that Boeing's would offer a lower price while Northrop Grumman's would have greater range and load-carrying capacity. Northrop chief executive officer Wes Bush said the rules in the current tanker competition—the service's third since 2001—favored the smaller Boeing entry.

Deputy Defense Secretary William Lynn said Pentagon officials "are disappointed" by Northrop's withdrawal. Typical of supporters of the Northrop bid, Sen. Richard Shelby (R-Ala.) told reporters: "The Air Force had a chance to deliver the most capable tanker possible to our warfighters and blew it." Typical of those favoring the Boeing entry, Rep. Norm Dicks (D-Wash.) said he had been assured by Defense Secretary Robert Gates that the Pentagon would proceed with the planned tanker acquisition, even after being left with just one aircraft as a candidate.

On March 4 Dicks was named chairman of the House appropriations subcommittee that writes the Pentagon's budget, replacing Rep. John Murtha (D-

Pa.), who died unexpectedly after surgery on February 8. Murtha's career was marked by power and controversy, and he established himself as a strong friend of the defense and aerospace industries. In 1974 Murtha became the first Vietnam veteran in the House of Representatives. He drew praise and criticism for using Capitol Hill's earmarks process to bring federal dollars to his Pennsylvania district. Supporters marveled over his attention to detail on aerospace and military concerns. *The Wall Street Journal* dubbed the congressman a "defense stalwart." Murtha had been receptive to the idea, now defunct, of a 'split' tanker purchase for the Air Force, with Boeing and Northrop both providing aircraft.

Murtha was "exasperated" that the government was taking so long to give troops the new refueling airplane they need. In a telephone interview with this author two years ago, Murtha said, "Our airmen need a new tanker on the ramp, ready to fly, and they need it now."

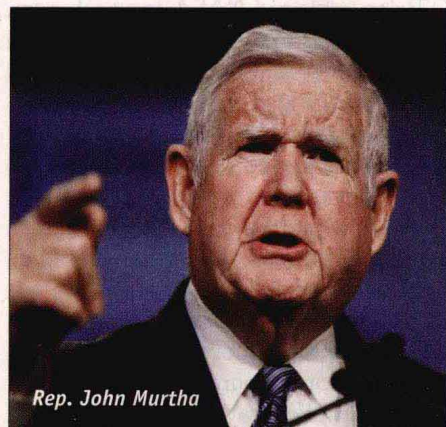
Dicks is another defense expert and, like Murtha, is renowned for earmarks. He is an unabashed champion of Boeing, the largest manufacturer in his state. Kyung M. Song of the *Seattle Times* pegged Dicks as "A much more expansive personality than Murtha was, the type who instinctively holds elevator doors ajar for late dashers." Dicks is expected to maintain close watch on the KC-X competition as the Air Force contemplates its next step.

F-35 JSF delay

Pentagon officials announced in February that they are implementing a delay of about one year in the F-35 Lightning II Joint Strike Fighter (JSF) program,

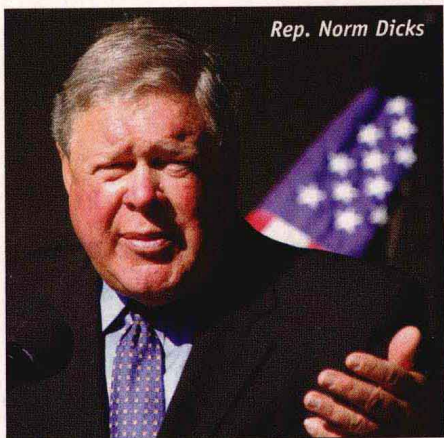


The Boeing KC-767 would be assembled in Washington.



Rep. John Murtha

Rep. Norm Dicks



which has experienced cost increases and technical difficulties.

Much is at stake. Assembly of the Air Force F-22 Raptor and Navy F-18E/F Super Hornet will end in 2012, leaving the JSF as the only U.S. fighter in production. At the height of the Cold War in 1956, 26 production lines in the U.S. were turning out 10 types of fighters.

Of 168 test flights planned for JSF in calendar year 2009, just 16 were completed. A Pentagon report says F-35 unit costs have increased 54% since the contract was awarded in 2001, while Lockheed officials say the figure is 38%. Gen. William Fraser, head of the USAF Air Combat Command, said in February that initial operating capability, or IOC—the milestone that marks an airplane's entry into service—will "slip significantly" from its one-time goal of 2013.

Intended for the Air Force, Marine Corps and Navy and a dozen overseas users, JSF is the most ambitious aircraft program in history when measured in dollars, with likely sales of about 4,500 aircraft totaling more than \$700 billion.

Deputy Defense Secretary Lynn says JSF's development schedule will slip "12-13 months" beyond what officials expected when they restructured the program in February. Air Force chief of staff Gen. Norton Schwartz signaled his impatience by warning that the program may breach the Nunn-McCurdy Act, which requires the DOD to report to Congress any cost increase of 15% or more and also requires a congressional review of alternatives. Schwartz also faulted his colleagues in the Pentagon, shortly after the secretary relieved the Marine two-star general in charge of the

fighter program.

"It would be disingenuous of me to say when we underperform, it's exclusively industry's problem," Schwartz said at a press conference. "Our inability to manage requirements [is] reflected, our ability to manage funding is reflected."

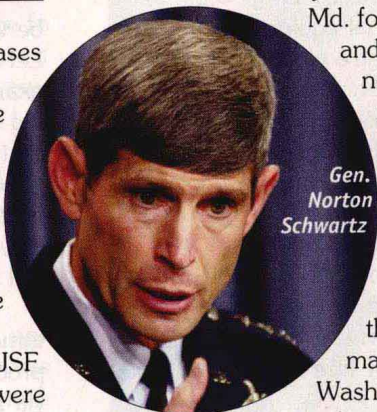
The Marine Corps is slated to receive its first F-35B models in 2012; the Air Force is expected to receive the F-35A in 2013 and the Navy the F-35C in 2013. But technical glitches grounded the first Marine F-35B to reach the test facility at Patuxent River,

Md. for several weeks, and the F-35C has not yet made its maiden flight.

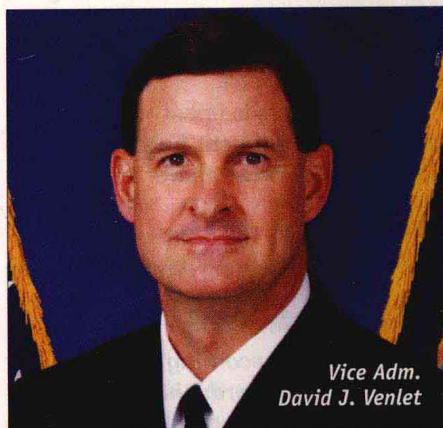
In the February restructuring, Gates relieved Marine Maj. Gen. David Heinz, the JSF program manager. Many in Washington saw this as a show of determina-

tion by Gates, not a reflection on Heinz, who did not cause JSF's problems. Gates said he would raise the program manager's job from two- to three-star rank. To replace Heinz, Gates was expected to name Vice Adm. David J. Venlet, a naval flight officer with an aerial victory to his credit: On August 19, 1981, Venlet was back-seater on one of two Navy F-14 Tomcats that shot down two Libyan Sukhoi Su-22 "Fitters" over the Gulf of Sidra.

Gates withheld \$614 million in performance award fees from prime contractor Lockheed Martin. "A number of



Gen. Norton Schwartz



Vice Adm. David J. Venlet

key goals and benchmarks were not met," Gates told reporters, adding, "the taxpayer should not have to bear the entire burden of getting the JSF program back on track." In a statement, Lockheed Martin said it has been working with military officials "on a plan to get the program back on track" and is "committed to stabilizing F-35 cost [and] affordability and to fielding the aircraft on time." A source told the author of this column that Lockheed hopes to recoup some of the withheld funds by meeting revised incentive goals.

The F-35 is facing delays and cost overruns.



Leaders in the Air Force and Navy, warning of a "fighter gap," want to resume production of "legacy" fighters like the F-16 Fighting Falcon, order larger numbers of F-22s, or increase the Navy's F-18A/F purchase. None of these steps is seen as likely, given Gates' efforts to make JSF succeed.

New TSA chief nominated

President Obama has selected retired Army Major Gen. Robert A. Harding to lead the Transportation Security Administration. Before retiring from the military, Harding was deputy to the Army's chief of intelligence and earlier served as director for operations in the Defense Intelligence Agency. He retired from the Army in 2001, after 33 years of service.

In 2003, he founded Harding Security Associates, a defense and intelligence contracting firm he sold in 2009. The appointment follows the withdrawal of the previous nominee, Erroll Southers, who faced a confirmation battle.

Robert F. Dorr

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