

TWENTYFIFTH EUROPEAN ROTORCRAFT FORUM

Paper N° L2

TILTROTOR SIMULTANEOUS NON-INTERFERING (SNI) OPERATIONS

BY

F. AGUILERA
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
UNITED STATES OF AMERICA

SEPTEMBER 14-16, 1999
ROME
ITALY

ASSOCIAZIONE INDUSTRIE PER L'AEROSPAZIO, I SISTEMI E LA DIFESA
ASSOCIAZIONE ITALIANA DI AERONAUTICA ED ASTRONAUTICA

)

)

)

Tiltrotor Simultaneous Non-Interfering (SNI) Operations

Frank J. Aguilera

Deputy Director

Aviation Systems Capacity

National Aeronautics and Space Administration (NASA)

Ames Research Center

• **NASA's commitment to improving the National Airspace System**

All aviation users are experiencing increased delays, decreased efficiency and escalated operational costs according to recent studies of the National Airspace System (NAS) by state and local transportation authorities and private industry. These studies suggest that the causes are insufficient capacity, limited access, and restrictions in the NAS. With continued projected increases in air travel, this situation can only get worse. Other studies project unacceptable delays occurring by 2005 if new technologies or new operational procedures are not pursued aggressively.

NASA has responded to this critical national problem by developing an enabling technology goal in it's Aeronautics and Space Technology Enterprise's "Pillar One: Civil Aviation" –

"While maintaining safety, triple the aviation system throughput, in all weather conditions, within 10 years"

An Aviation Systems Capacity Program was established to bring research and technology to fruition, in close partnership with the Federal Aviation Administration and the aviation industry, so they can achieve this aggressive goal.

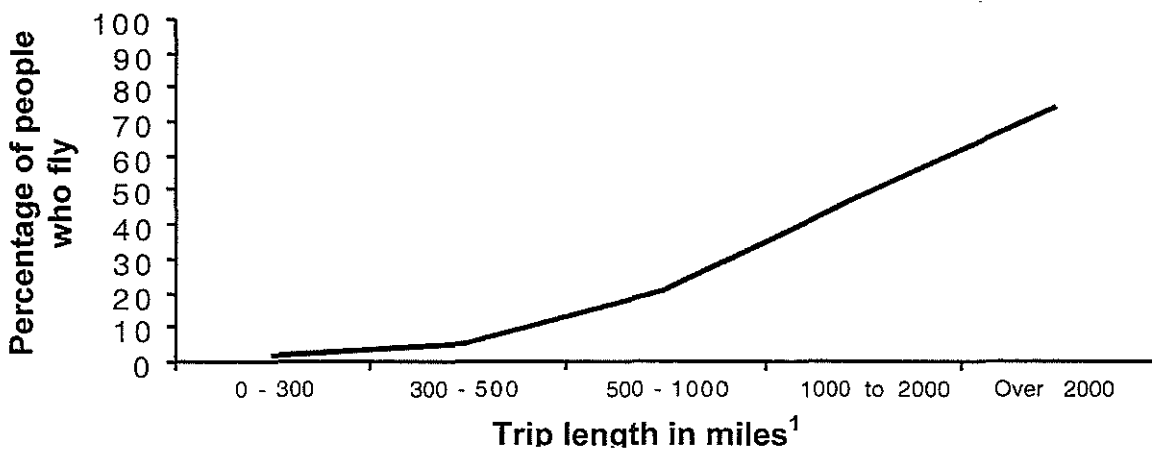
The results of the Aviation Systems Capacity Program, in concert with NASA's other programs in Aviation Safety and Environment, will enable a new era of safe, clean, quiet and affordable air travel.

Dr. J. Victor Lebacqz is the Program Director of the NASA Aviation System Capacity Program. NASA Ames Research Center is the NASA Lead Center for this effort.

• **Aviation Transportation System**

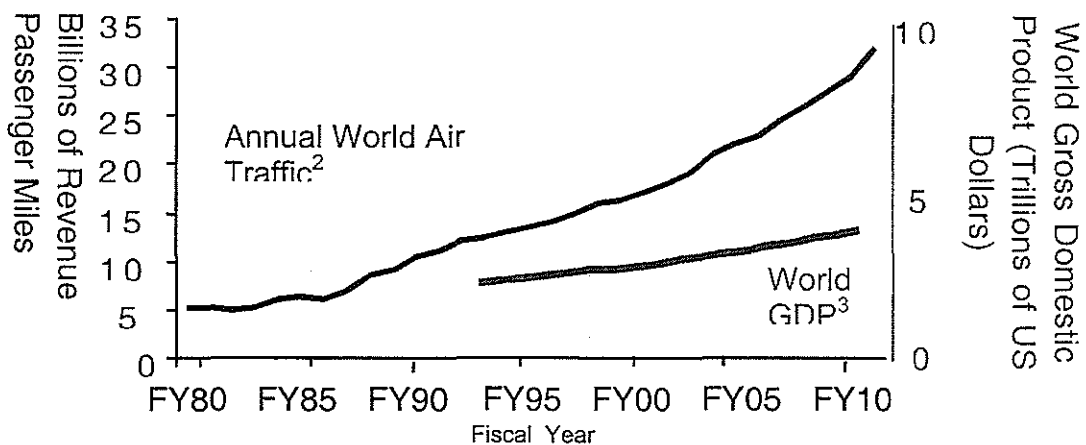
As we begin the 21st century, the dominante mode of global trasportation will be aviation based. Economic markets will continue to expand causing more burden on the existing transportation infrastructure systems.

Transportation represents 11% of our \$7 trillion economy. Air transportation is fundamental to our quality of life and is the primary mode for long-distance travel -- accounting for over 50% of all passenger travel over 1,000 miles.



1. Source: DOT Bureau of Trans Statistics, 1995 American Travel Survey: US Profile, Fig 3 and Table 3

Air transportation also enables fast, global shipping and is critical to commerce. It is a fundamental service that makes electronic purchasing and shipping via the internet a viable commercial medium. World wide air transportation is growing at a higher rate than the global Gross Domestic Product (GDP).



2. Source: FAA Aerospace Forecasts, Fiscal Years 1999-2010, March 1999, page III-37

3. Source: FAA Aerospace Forecasts, Fiscal Years 1999-2010, March 1999, Table 4, page X-6.

Europe is also experiencing similar air traffic control delays. In a recent publication it was stated that a 39.3 percent increase in air traffic control delays was experienced last summer, over the summer of 1997, with only a 4.95 percent increase in traffic. In this same article Eurocontrol has acknowledged that existing capacity enhancement measures will not be sufficient to cope with the anticipated traffic surge.¹

¹ Aviation International News, June 1999 Vol. 31 No. 9, page 26

We must look at alternative opportunities to help solve the growing issue of delays. Traditionally we have looked at increasing capacity by building new airports, increasing runway lengths, adding new runways or decreasing the spacing of arriving or departing aircraft from the terminal area. As we are all painfully aware, safety and environmental constraints make these traditional options difficult to implement.

• Tiltrotors as a Runway Independent Aircraft utilizing Simultaneous Non-Interfering (SNI) Operations to increase airport capacity

From the very beginning, aviation pioneers knew that the problem of take-off and landing would be the most difficult one to master. Changing the state of the aircraft from one in which it is supported by its landing gear on the ground to one in which it is supported by aerodynamic forces in flight, and vice-versa, is still the most complex and sometimes dangerous maneuver. Thus, from earliest times, the concept of the airfield or airport was accepted as a natural part of aviation. As aircraft became larger and more complex, the airfields necessary for their operation became even larger and more remote from population centers because of the ever-increasing requirements for available and inexpensive land.²

These large airports however are showing signs of capacity stress. Recent studies of the United States National Airspace System (NAS) by state and local transportation authorities and private industry suggest that insufficient capacity, limited access, and environmental restrictions have escalated operational costs, increased delays, and decreased efficiency for all users. The Air Transport Association estimates these delays result in an annual operating loss for US airlines of \$3.5 billion. With continued projected increases in air travel, this situation can only get worse.

² Vertiflite May/June 1988 (Aircraft Without Airports by Hans Mark and Robert R. Lynn)

To enhance the NAS capability to meet the expectations of the users, an innovative approach is required on a national level. The major challenges are to:

- accommodate projected growth in air traffic while preserving and enhancing system safety
- provide all airspace system users with more flexibility and efficiency in the use of airports, airspace, and aircraft
- reduce system delays
- enable new modes of operation that support the commitment to “Free Flight”
- maintain pace with a continually evolving technical environment.

Tiltrotor aircraft can become part of the capacity solution. Let’s imagine an operational concept where tiltrotor or other STOL aircraft can operate in an airport environment where large transport operators benefit from an additional stream of traffic coming into the terminal area but in doing so increases airport capacity. This can be done with concepts like Tiltrotor Simultaneous Non-Interfering (SNI) Operational developments.

- **SNI Operational concept**

A new opportunity was identified by a recently completed Boeing Rotorcraft “Requirements for the Next-Generation National Air Traffic Management” study, sponsored by NASA³. This study concluded that, if simultaneous and non-interfering (SNI) operations (Fig 1.) were allowed at airports, the airport capacity could be enhanced significantly. This means tiltrotor (and other rotorcraft or STOL) could operate at large airports IFR, without interfering with fixed wing traffic that use runways at the airports. Tiltrotor aircraft could augment the feeder commuter aircraft at congested hub airports by landing

³ Rotorcraft Requirements in the Next Generation Air Traffic Management System, Boeing Final Report, Feb. 98

at dedicated airport located vertiports, taxiways, or stub runways. Also, the tiltrotor could also utilize smaller and general aviation airports as part of new service to a distributed populace. Hence, tiltrotor service could be implemented without the challenge of developing new vertiports first, which would be necessary if airports were by-passed entirely.

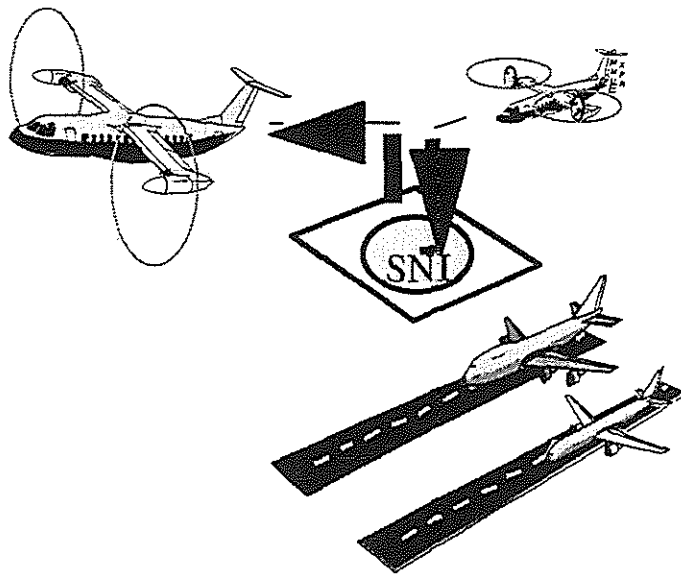
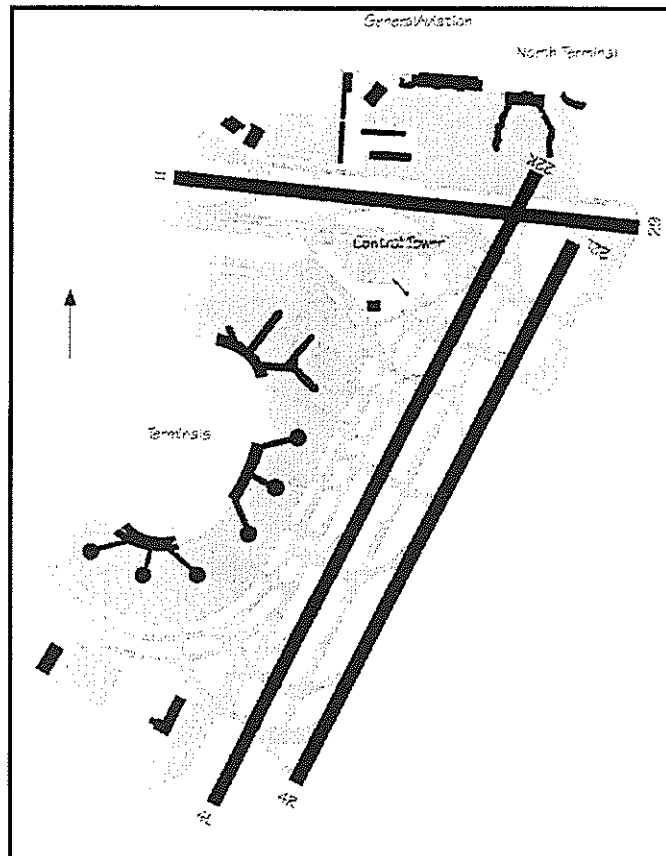


Fig 1. SNI allows Tiltrotors to off-load traffic from congested airports

- **SNI operational benefits**

The benefits of tiltrotor SNI operations are best explained by using an example since benefits could vary depending on airport layout and operational requirement.

Current operations at Newark Airport include both long haul transport and short haul commuter traffic. The two parallel runways 4L and 4R or 22L and 22R are primarily utilized for takeoff and landing of long haul transport traffic, while runway 11 or 29 is used primarily for commuter traffic takeoff and landing, see figure 2.



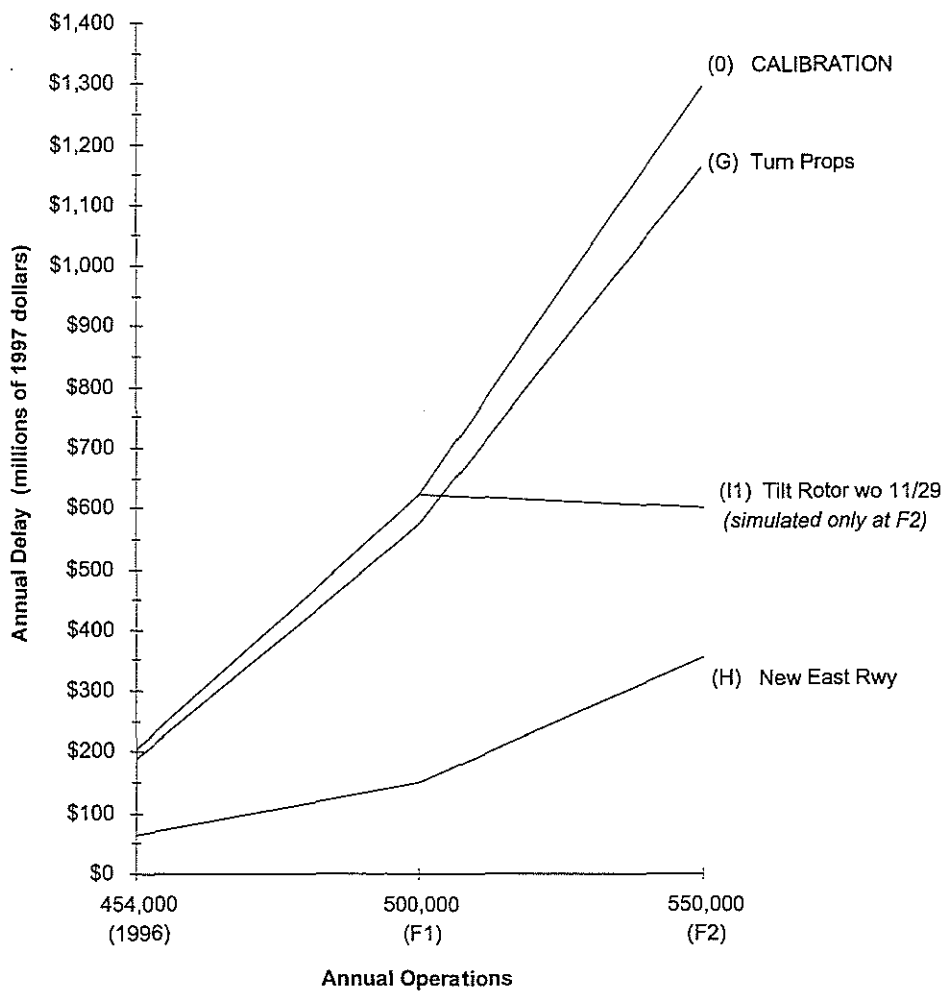
Newark Airport (EWR) Figure 2.

Capacity is impacted in terms of increased traffic delays at Newark Airport during IMC (IFR operations) because of runway conflicts and spacing requirements between fixed-wing commuter and fixed-wing long haul traffic.

If large commuter operations (aircraft weighing more than 41,000 pounds and up to 255,000 pounds) were off loaded from the impacting commuter runway and Tiltrotor aircraft were to operate in a Simultaneous Non-Interfering (SNI) approach and departure operation, runway delays would be reduced significantly

allowing long haul traffic operations to increase. This increased capacity could be as high as adding another runway and utilizing it 50% of the time.

The Federal Aviation Administration (FAA) is conducting benefit assessments⁴ of utilizing tiltrotor aircraft with SNI operations as an option to reducing delays and thereby increasing airport capacity see Figure 3.



ANNUAL DELAY COSTS -- 3 DEMAND LEVELS (in millions of dollars) -- EWR
(with Tilt Rotor simulated at F2), Figure 3

• **SNI development requirements and next steps**

As was detailed in the previous section there is an opportunity to bring about some major operational changes at hub airports in order to increase airport capacity by utilizing SNI operations.

To further evaluate the benefits of implementing Airport SNI operations at other airports, site specific benefits analysis will have to be conducted as was accomplished at the Newark Airport by the FAA. This is most important since each airport configuration differs significantly not only for arrival and departure patterns but also for runway and taxi way layout. SNI operation need to be coordinated with ground infrastructure capabilities such as passenger terminal areas and tarmac areas in order to fully acquire maximum benefits.

In order to demonstrate proof of concept and gather statistical operational benefits data for increasing airport capacity, it would be beneficial to demonstrate that SNI operations can be performed at airports, under IMC, without impacting conventional fixed wing transport aircraft runway traffic in both simulated and actual conditions.

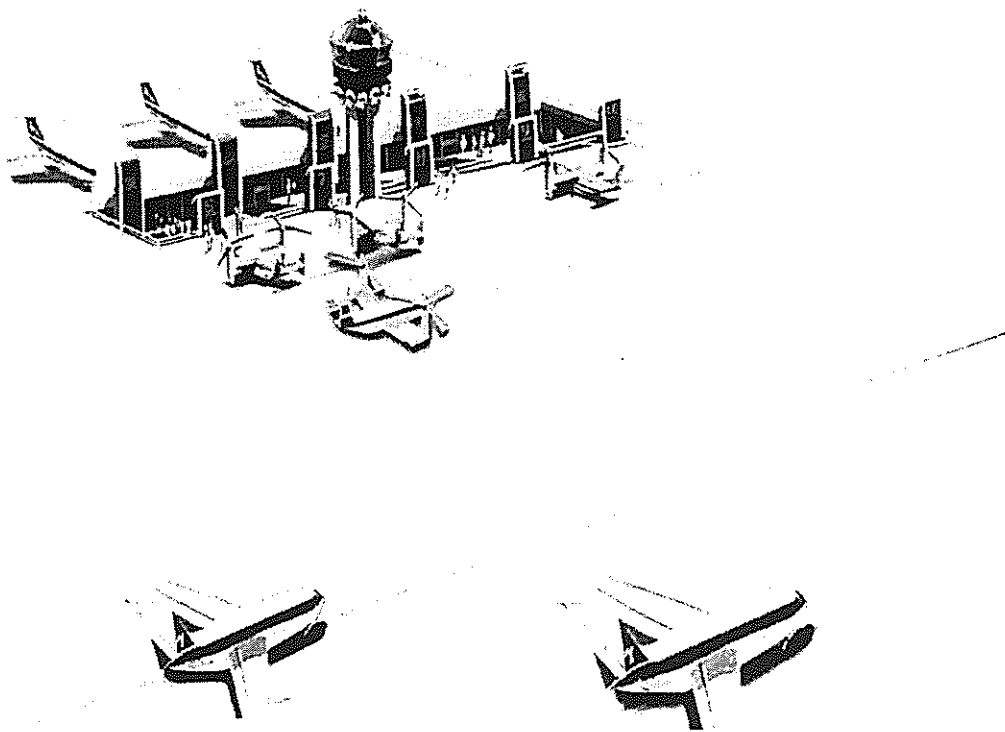
Following the benefits assessment phase it would be essential to develop airport terminal area SNI operational criteria and develop any proposed changes to terminal instrument procedures in close cooperation with the FAA.

As with any other changes to the Air Traffic Management System, environmental and safety issues will be most important during any SNI operational developments and should be included in an operational evaluation plan.

Piloted simulations of SNI operations could be performed while simulated fixed wing aircraft land on conventional runways. Simulations could also include air traffic control interfaces. One approach to a simulation would be to utilize aircraft simulators (fixed wing and VSTOL) and a control tower simulator linked together in a virtual environment in order to develop the vehicle performance

⁴ Airport Capacity Enhancement Design Team Study (Newark International Airport) draft, Jan. 1999

requirements, operational aspects and human factors aspects at a notional airport see figure 4.



Notional Airport with SNI operational environment, Figure 4

• **Conclusion**

As the United States civil aviation community enters its second century of operation, a myriad of factors will challenge our ability to maintain leadership in both aviation safety and operational capacity. By the year 2016, aviation customers will be operating in a global environment where increased traffic growth is expected. World revenue passenger miles are expected to more than double over the next 20 years, with airlines around the world carrying two and a half billion passengers each year. Air cargo will also grow, averaging a 6.6 percent increase per year during the next 2 decades. The market for new aircraft over the next 20 years will be almost one trillion dollars—more than twice the

size of the market during the past 20 years. United States domestic passengers will double and commuter / regional passengers will triple, together totaling over one billion passengers carried in the year 2010⁵.

With this outlook for aviation transportation which envisions a challenging operational environment with increased delays, it is imperative that we propose unique solutions. Developing SNI operations is an option to reducing delays and thereby increasing airport capacity is only one such solution.

⁵ Air Traffic Services Performance Plan, U.S. Department of Transportation, Federal Aviation Administration, October 6, 1998.