

Challenges in Indian Civil Aviation and Opportunities to Designers and Manufacturers - 2007

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Abstract

The paper discusses the knowledge base of the civil aviation Industry in particular and the manufacturing sector that supports transport sector with special reference on opportunities to designers and manufacturers of products for civil aviation application. Civil Aviation sector is one of the key sectors for Indian economy with global participation. The paper is focused on: The Global and Indian Civil Aviation Scenario, Challenges in Civil Aviation, Aircraft Manufacturing Industries and Opportunities for Designers, Airport Infrastructure and Challenges, New Concepts in CNS/ATM, Research Opportunities in Civil Aviation

Key words: Enhanced situational Awareness Systems Clear Air Turbulence, ILS, MLS, GPS, VOR/DME, Area Navigation (RNAV), Communication Navigation Systems (CNS), Air Traffic Management (ATM)

I. INTRODUCTION

A. Civil Aviation Scenario

The need for liberalization in Indian civil aviation was felt in 1989 by enunciation of new aviation policy. The monopoly of national carriers Indian airlines, and Air India was dismantled in 1994 when the national economy went for a massive change with emphasis laid on globalization, liberalization and privatization thus allowing large number of private carriers to enter domestic skies. The increased competition amongst private players led to greater connectivity to cities, better services to passengers and higher growth for national economy.

Over the last few years, the civil aviation sector in India is witnessing a boom, as the domestic air traffic and Passenger movements, International air traffic and cargo movements have recorded exponential growth. This growth has been largely fuelled by the Government's open sky policy of measured liberalization. Experts observe that India will overtake North America and China as the world's single largest aviation market by 2025 in Passenger and freight movement. India would account for 10 per cent of the world aerospace industry by 2020. Infrastructure development, skilled and trained manpower, updated communication and navigational facilities in the airport are the key areas for large Capital investments. Issues of infrastructure development, introduction of new technology concept of satellite based navigation, aircraft fleet augmentation in civil aviation sector are the potential area for growth. The domestic aviation industry had 125 operating aircraft three years ago. They are now more than 350, and the number is expected to cross 1,000 in the next five years. Airports Authority of India (AAI) manage 127 airports for civil

operations. There were 50 operational airports six years ago. Now, there are 80 active operational airports. India would have 500 airports, including the number of merchant (private) airports by 2020. The Indian aviation market is growing at the rate of 18 per cent annually. The Civil aviation Industry attracts huge foreign direct investment for Airport Infrastructure development. New business areas such as Aircraft Maintenance, Repair and Overhaul (MRO) facility are opening up. India will be emerging as the MRO hub for Asia-Pacific.

Many developed countries regard civil aviation sector as very important because of its influence on the national economy, technical capability and strategic requirement. Spin offs into a broad and varied range of industrial sectors has also been possible. It is an industry that uses varieties of modern technologies and number of components / assemblies and equipment, promising high employment opportunities.

II. AIR TRAFFIC STATISTICS AND CONSEQUENTIAL CHALLENGES

A. Air Traffic Statistics

The year 2006 has been remarkable for growth in air passenger traffic in India. The airlines have carried 96.4 million passengers in the year 2006-07, a growth of 31% over the corresponding period of 2005-06 and this is estimated to reach 114 million by the end of March 2008. There are at present 76 International and 15 domestic airlines operating in India. Major air traffic activities are experienced with increased growth rate at Hyderabad 37%, Chennai 30.4%, Bangalore 31%, Mumbai 15.3% and Delhi 19.6%. This has brought considerable amount of congestion both in air as well as in ground. AAI on its part has taken urgent steps in meeting this phenomenal growth

both for augmenting ground infrastructure as well as air space restructuring.

The Overall growth in respective traffic categories in 2007-08 over 2006-07 is:

- Aircraft movements - 27.2%
- Passengers movements - 28.5%
- Cargo movements - 11.9 %

The traffic growth indicates large employment opportunities. The human resource requirement is projected with large pool of expertise in the following areas of business.

- Qualified and trained pilots
- Human Resources for Airline operation
- Ground Handling support services
- Passenger Facilitation Managers for Airlines and Airports
- Aircraft maintenance Engineers,
- Aircraft maintenance technicians,
- Cabin crew, Airline Traffic managers
- Air Traffic controllers and Aviation
- Communication Experts,
- Ground handling and baggage handling staff,
- Cargo handling staff
- Terminal and Facilitation Managers
- General Engineering Maintenance Managers
- Building Constructors and Maintenance Managers of all Services
- House Keeping and Hospitality Managers
- Safety Systems and Security Managers
- Environment, Estate Management and Legal consultants
- Regulatory mechanism managers
- Quality Audit and ISO Certification consultants
- Aerodrome Licensing Advisers

B. Aircraft Statistics

It is estimated that the world jet airline fleet will be around 20,000 by 2015. A major share of this fleet will be in North America and Asia. However, manufacture of these aircraft is predominantly by Boeing and Airbus Industries. Airbus has developed new products in the form of A319, A340 and A380 and Boeing with B-777 and B737-800. There are plans to build 100 seater aircrafts by Asian companies in China and South Korea as medium sized aircrafts have high potential for short haul operations. Aircraft manufacturing is mainly dominated by Europe, except for the Bombardier group in Canada and Embraer in Brazil. The organizations with ability to manage huge financial investments for developing new aircrafts will soon emerge out.

C. Aircraft Demand Forecast

It has been forecasted that India requires substantial number of various types of aircraft up to 2010. The estimates are 165 trainer and general aviation aircrafts (< 10 seats), 171 Business and commuter regional aircraft (10-70 seats) and 153 large commercial passenger aircraft (over 70 seats), apart from 55 helicopters (5 to 10 seater). These present a real opportunity for local manufacturer / assemblers as offset arrangements.

D. Airport Business Partners

There are very many business stake holders in Aviation Business. Public services with players from Private Partnership, Airport Planners and Consultants, Building Constructors, Equipment manufactures, IT developers and managers, Airline Operators, Regulatory Authorities, Security Personnel, Safety enforcers, Environment Controllers, Commercial business partners, Financial Managers, Infrastructure maintenance managers and System operators, Infrastructure operators, Managers, Advisers, Project Consultants and Administrators, Communication Systems operators and Managers, Oil Companies supplying Aircraft Turbine Fuel, Fire & Rescue services, Bomb and Detection Squad, Civil Aviation Security personnel, Airport security service personnel, Taxi, Cars, Auto and Bus operators, Food Courts, Commercial business on Bank, Posts, Foreign Exchange, Medical Assistance, House Managers, Facilitation Centers and shops, Felicitation services to VVIPs, Publicity/Advertisements entities, Terminal Managers, Flight Information Announcers, Baggage Handlers, Traffic flow managers, Airline Security and Ground support managers, large crowd of constructors and maintenance operators, skilled and semi-skilled workers and staff, Cargo Operators, Cargo Agents, Quarantine Services, etc.. Around 100-120 agencies are operating including touts and agents for unknown illegal activities in a major airport like Chennai International Airport.

Airports Authority of India is responsible to operate and manage the airspace, regulating air traffic flow both in space and ground, passenger and Baggage including cargo handling in the Terminal, passenger facilitation services including VVIP felicitation, general administration and management of various agencies in the Terminal Building, monitoring operational activities and city side traffic management, regulating and managing the security activities in the airport, Fire Fighting and Rescue services in case of emergencies.

E. Challenges Consequential to Growth

The complex business structure with multiple players poses challenges. The major challenges faced in Indian aviation are:

- a. Stressed airspace in Indian FIRs
- b. Stressed air traffic services at destination airports
- c. Constraints in Runway capacity, apron, Parking and ground movements
- d. Congested terminal space in arrival and departures
- e. Inadequate baggage and passenger handling terminal facilities
- f. Security and regulatory strains on traveling public
- g. Inadequate transport system on city side for passenger evacuation

The challenges are managed with the following augmentations with a focus to convert the challenges into opportunities.

- Full utilization of runways with parallel taxiways to increase runway capacity
- Extension of runways where payload penalty is experienced
- Strengthening of Air traffic services and use of satellite based navigation system to reduce flying time
- Allocation of optimal levels through a modern air traffic management
- AAI has restructured routes in air flow management with augmentation of CNS/ATM facilities
- EMMARSH & RVSM for reduced flying time and fuel efficiency
- Modernizing CNS/ATM facilities with introduction of ADS-C, FDPS, ASBS.
- MSSRs with MODE-S capabilities & CPDLC has

helped in reducing the constraints in air traffic and also stress on existing CNS/ATM facilities to a great extent

IV. AREAS OF INTEREST FOR MANUFACTURERS

Indian aviation has wide opportunities for aircraft designers and manufacturing companies. Manufacturing of an aircraft is a complicated exercise involving all forms of Engineering, like Aeronautical, Mechanical, Electrical, Electronics, and Structural etc. The assemblies and sub assembly components which contribute to manufacture an aircraft is scarce and the industries in India should grab the opportunities to establish manufacturing units. India has few industries which manufacture certain components like engines, airframes etc but it is totally insufficient to the scale of demand. Hence, Indian Industries need to attach greater importance to attain self-reliance. The manufacturing opportunities are highlighted in the following areas.

A. Aircrafts

Very Large Transport (over 600 seater) aircraft for non stop routes / Hybrid aircraft (VTOL + Fixed Wing Aircraft)

B. Airframe & Engines

Engines: ETOPS: Extended range twin engine operations enabling flying for greater duration. Energy Efficient engines: (lower fuel consumption) Advanced Ducted Prop engines High Bypass ratio engines with thrusts rising over 100,000 lb. Wide chord composite fan blades, fan hub frame, and fan disk etc.

C. Avionics

ESAS: Enhanced Situational Awareness System. It offers operational safety benefits to all airlines all the way from gate preflight procedures, through taxi and take off, cruise and landing to taxi and arrival at the next stage gate. Could also include detection of wind shear, clear air turbulence system (CAT), and enhanced vision for gate to take off and landing procedures

D. Approach Precision System

New precision landing receiver incorporating the functions of ILS, MLS and GPS. The cockpit display would be probably an ILS look like so that different airlines could use them.

E. Enhanced Vision System

Uses Infrared or mm wave radar to produce an image of the runway on a head up display. The system uses navigational data from aircraft sensors and computers to make low visibility landings.

F. Fly By Wire Control

Incorporates algorithms to reduce instabilities and correct for wind gusts. Data links that allow the crew to download aircraft status and maintenance information to ground control.

G. Automatic Docking Systems:

Having identified the aircraft, the system knows where to stop the aircraft enabling the passengers to disembark by a low cost passenger bridge.

H. Aeronautical Telecommunications Network

Reduces airborne avionics and eases cockpit crew work by introducing data links designed to automate routine air traffic control communications.

I. Communications

Future Air Navigation system- will comprise of GATS (Global Air Transportation System) comprising many satellites which will provide automatic data and voice transmission with pin point accuracy to all aircrafts carrying transponders to an estimated accuracy of 15 meters.

J. Materials

Use of fiber optics for temperature probes capable of operating at 1300c piezoelectric sensors (acoustic omission sensing); Beta alloys: Replace aluminium which is anti corrosive.

K. Cabin/Interiors

Cabin Management System - in seat ordering of goods, duty free sales, video / audio control library / In-flight information, and recording and reporting cabin condition for maintenance after flight.

L. Vacuum Toilet System

Rotating disc flush valve technology and integrate rinse water valve and Vacuum breaker, Convertible seats Business to economy or vice versa Water Mist Cabin, Fire Retarding System, In-flight entertainment, Personal videos.

V. AIRPORTS

There is congestion in air space and crowding at airports due to rapid growth. Available airport capacity can limit increases in frequencies. Increases in aircraft movements are already restricted at major airports like, Delhi, Mumbai, Bangalore, Chennai and Hyderabad. This has resulted in growth at other city airports, resulting in expansion of the present airports and creation of new airports.

There are business potentials in Airport terminals,

runways construction, ATC equipment supply, and automation and ground support services. The share of equipment is around 30% of the total airport infrastructure market. The international market for airport infrastructure development is projected to be at \$300-350 billion up to the year 2010. Human workforce is conveniently used in construction activity. The human resource has become less efficient and more costly. Therefore, designers in construction Industry should look for special structural designs with cost effective technological methods in construction techniques as a substitute for less efficient human workforce. The emerging trends indicate that technology driven market will drive the manufacturing sector to identify new construction materials. Asia-Pacific region is considered to continue the largest activities in airport construction and modernization projects, accounting for more than 35% of the world investment on infrastructure development. India plans to invest approx 150 billion USD in modernizing existing airports and develop new ones.

VI. AIR TRAFFIC MANAGEMENT AND COMMUNICATION, NAVIGATION AND SURVEILLANCE (CNS/ATM)

Air space in India is congested due to growth leading to delays. Action on war footing is underway by modernizing CNS/ATM facilities and for optimal use of airports. With this automation and modernization of CNS facilities the airspace will get decongested to a large extent in the next few years. New concepts and designs in air traffic control like the use of SATNAV and other futuristic concepts in CNS/ATM Systems is expected to add to the optimal use of air space.

CNS /ATM facilities are quite complicated and have to be too accurate for detection of aircraft, computation of data and signal processing with precision. Major leaders in manufacturing of Communication, Navigational and Surveillance equipments are mostly from Europe and North America. As the system undergoes rapid changes in technology and design, India faces a major challenge thereby creating opportunities for Industries in the field of Electronics and Communication to bring out new systems for use in civil aviation sector.

VII. INDIAN REQUIREMENTS UNDER THE NEW AIRPORT CONCEPTS

It is expected that India will buy new commercial jet aircraft worth Rs, 15,000 cr by 2010. The market, industry and the Government are fully aware of these requirements. Strategies to manage the requirements include offset production, collaboration to make components, and manufacture of small to medium size aircrafts. If strategic planning is done, the country would

absorb the required technology fully by 2020 by collaboration and joint ventures.

India realizes the need for the most advanced and appropriate technology for trunk routes and international travel, which will be cost effective and reliable. However, India needs modern technology services, more aircrafts and ground infrastructure in many towns and small cities that is rugged, less capital intensive, and less maintenance. These requirements create fertile ground with great business opportunities.

VIII. DEVELOPMENT OF AIRPORT AND AIRSPACE INFRASTRUCTURE

Development and improvement in airport and airspace infrastructure is a continuous process. The following thrust areas have been identified for developments to meet the challenges posed by the increased traffic growth in India

- Expanding and remodeling of Terminal buildings.
- Construction of new Terminal buildings with new construction technologies.
- Air space management including introduction of new concepts in air traffic flow management as guided by ICAO.
- Airside development and improvements in runways, taxiways, aprons.
- Automation and upgradation of CNS/ATM systems
- Automation of customs and immigration Checks.
- E-security check, modernization of passenger baggage movement.
- City side development including modern Vehicle parking system, business centre, hotel chains, multiplexes, and logistic centres.
- Improvement in City-Airport connectivity

These developmental plans assure great commercial opportunities.

IX. AIR NAVIGATION - ATC SERVICES

Air Traffic is managed through a well defined and procedurally documented Communication; Navigation and Surveillance services called CNS/ATM. CNS/ATM services are continuously upgraded to facilitate air traffic flow for smooth and safe operations both in air and ground. With increase in air transport demand, traffic congestion in the sky has also increased. In order to overcome the stressed situation, the following efforts are on for upgrading air traffic control systems and restructuring

airspace and airways through:

- a. Reduced Vertical Separation Minima (RVSM)- domestic airspace
- b. Operation and development of Area Navigation (RNAV)
- c. Establishing and enlarging safer and more efficient routes using the above two methods.

A. Reduced Vertical Separation Minima (RVSM)

It is a method of allotting flight altitude to increase the capacity of airspace by reducing the vertical separation minimum. This effects in

- a. Increasing airspace capacity-Provides 6 additional flight levels.
- b. Relief of congestion. More payload / more passengers.
- c. Reduction in traffic delays
- d. Fuel efficiency improvement
- e. Contributing to passenger comfort by flying on an optimum route at optimum altitude

B. Area Navigation (RNAV)

RNAV is a method in which aircraft device receives VOR/DME signals and GPS signals to measure their position. It increases options for routes compared to conventional traffic control. It benefits in

- a. Shortening of routes
- b. Reduction of noise
- c. Increase in number of routes
- d. Less work load for controllers and pilots
- e. Improvement in safety, efficiency and rate of flights

X. MODERNIZATION AND UPGRADATION OF CNS SYSTEMS

CNS - Communication, Navigation, and Surveillance are continuously upgraded with latest state of the art systems like Doppler VOR, Instrument landing systems. All airports irrespective of its size have DVOR for navigation purpose. Major airports are provided with reciprocal landing aids for aircrafts to land even under adverse weather conditions. Indian airports need systems like long range, medium range radars with secondary surveillance capability. These systems are currently procured from European and US market. What we need is manufacturers from within the country not only to design and produce products to the current needs but also to

come out with new products for future needs.

AAI has initiated a global plan with the aid of GPS for augmenting space navigation through its own Project called GAGAN jointly with ISRO. After America, Europe and Japan, India becomes the 4th in the world to install "GAGAN", the satellite navigation system at Bangalore. This enables India to manage the higher volumes of air traffic across subcontinent with greater safety and ease.

XI. RESEARCH & DEVELOPMENT - A NEED

Most of the CNS equipments are all imported, which are costly and cause time delay to reach India from supplier source. This type of dependency allows more time for installation and delays in providing the facility to the operators. There was an attempt to establish Research and Development unit with a concentration of improving and manufacturing indigenous CNS System. However, it was time consuming and cost intensive. At that stage, it was decided that import was better compared to spending time on development of these equipments indigenously. Now, the demands from Asia for CNS /ATM systems are high to justify indigenous manufacturing.

It will be wise if R&D groups work on these areas and Indian entrepreneurs concentrate on developing and manufacturing these equipments in India. This will not only provide employment opportunities for our engineers but also create a market to East Asian countries who import these equipments from USA or European countries. Crucial areas in aviation sector will have to be identified and research and development will need to commence. These may include engines and propulsion systems including advanced technology engines for aerospace planes, smart structures and the use of active control, composite structures, strategic materials, sensors, advanced avionics and flight simulation.

XII. OPPORTUNITIES: RESEARCH AREAS

A. CNS/ATM Systems

Electronic navigation research institute, Japan is focusing research on the Multi-functional Transport Satellite (MTSAT) in the following areas of CNS/ATM and Air traffic control.

- a. Study on Aeronautical telecommunication network
- b. Study on VHF Digital Link
- c. Study on CDMA Technology
- d. Study on Aeronautical Satellite Communication System
- e. Study on satellite based Augmentation System
- f. Development of Ground-based Augmentation System
- g. Study on GP path prediction technique under Category III operation

B. Air Traffic Control

- a. Study on Separation Minima
- b. Study on Dynamic Airborne
- c. Route Planning System in the Oceanic airspace
- d. Study on ATC Workstation in the Next Generation
- e. Study on Domestic Air Traffic Flow Management
- f. Study on Measurement of Human Factors

XIII. CONCLUSION

The growth of aviation in India has been challenging. The challenges have opened up great opportunities too:

- Today nearly 100 million jobs depends directly on the Industry Region dependant trade and tourism have picked up enhancing the economic benefit of air transport
- R&D opportunities are abundant for Indian Scientist, Researchers and Equipment manufacturers to work on aviation related applications.
- Foreign Direct investment increase In airports infrastructure development
- Global competition from CNS Equipment manufacturers for the CNS Equipment at airports.