UPES Centre for Continuing Education

FLEXIBLE USE OF AIRSPACE MANAGEMENT

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I also place on record my appreciation of the support provided by **Mr. AV Patwardhan** and other staff of **Vyas Library, NDA Khadakwasla**.

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Declaration by the Guide

This is to certify that the **Wing Commander Ajay Kumar Yadav**, a student of **MBA – Aviation Management**, SAP ID **500070252** of UPES has successfully completed this dissertation report on **"Flexible Use of Airspace Management"** under my supervision.

Further, I certify that the work is based on the investigation made, data collected and analyzed by him and it has not been submitted in any other University or Institution for award of any degree. In my opinion it is fully adequate, in scope and utility, as a dissertation towards partial fulfillment for the award of degree of MBA.

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ANSWER CHOICES	RESPONSES	
YES	89.93%	125
NO	10.07%	14
NO COMMENTS	0.00%	0
TOTAL		139

2. **Table 2:** Responses on Airspace blockage for IAF's VFR operations

ANSWER CHOICES	RESPONSES	
YES	56.83%	79
NO	40.29%	56
NO COMMENTS	2.88%	4
TOTAL		139

3. **Table 3:** Responses on Joint Usage of Airspace

ANSWER CHOICES	RESPONSES	
Do you see the IAF operations are able to accommodate civil flights	18.60%	24
IAF operations are getting affected severely	15.50%	20
IAF should encourage joint user aerodromes to support economy of nation	29.46%	38
IAF can fly in block timings to optimise the airspace and aerodrome utilisation	36.43%	47
TOTAL		129

4. **Table 4:** Responses on Usage of Airspace above FL 290

ANSWER CHOICES	RESPONSES	
Agree	80.15%	109
Disagree	19.85%	27
TOTAL		136

5. **Table 5:** Responses on Flexible use of airspace justifiable or not

ANSWER CHOICES	RESPONSES	
Yes	90.65%	126
No	9.35%	13
TOTAL		139

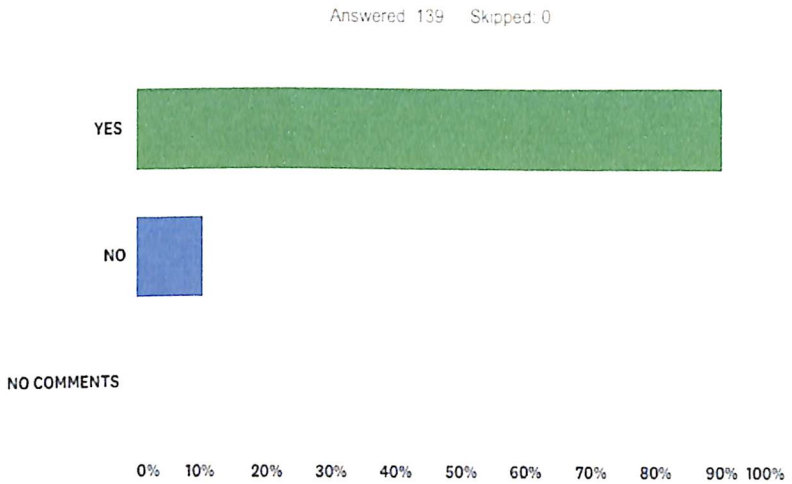
6. **Table 6:** Responses on Selective Clearance of FUA Routes

ANSWER CHOICES	RESPONSES	
Yes	45.80%	60
No	24.43%	32
The current sensor and communication capabilities of IAF permit simultaneous use of airspace by IAF and civil	29.77%	39
TOTAL		131

LIST OF FIGURES

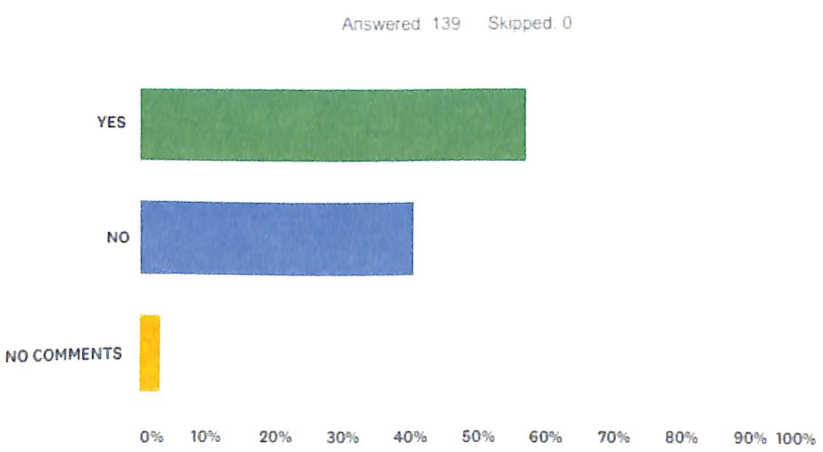
1. **Fig 1:** Utilization of airspace on Holidays by Civil sector

Q1 The IAF controlled airspace is underutilized or not used at all during Saturdays and Sundays at many places. Does the use of airspace by civil flights during such non-utilisation period be acceptable to you?

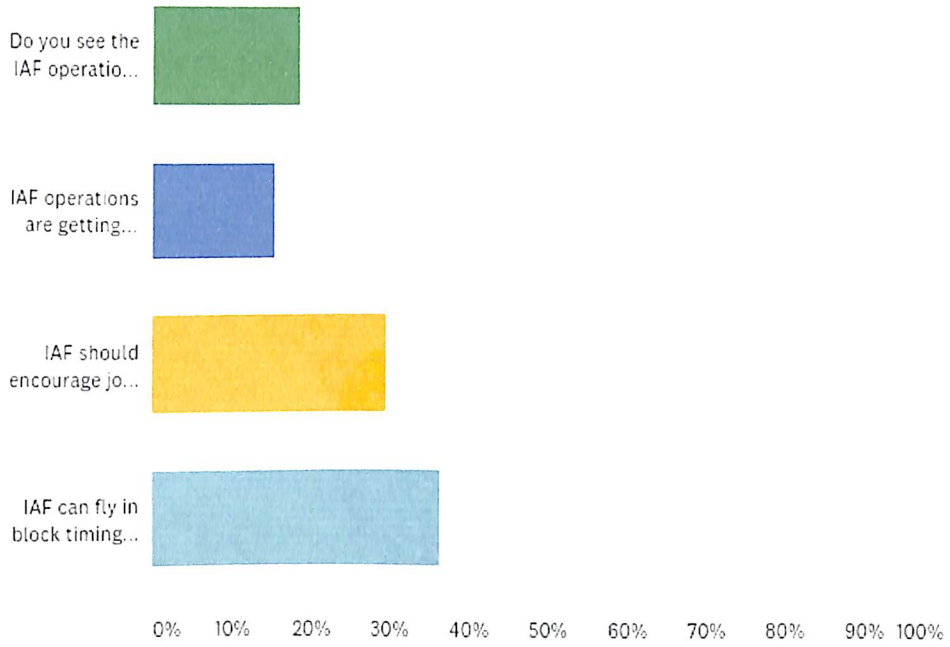


2. **Fig 2:** Airspace blockage for IAF's VFR operations

Q2 Do you think the IAF's predominantly VFR operations require stringent blocking of airspace for routine flying operations?



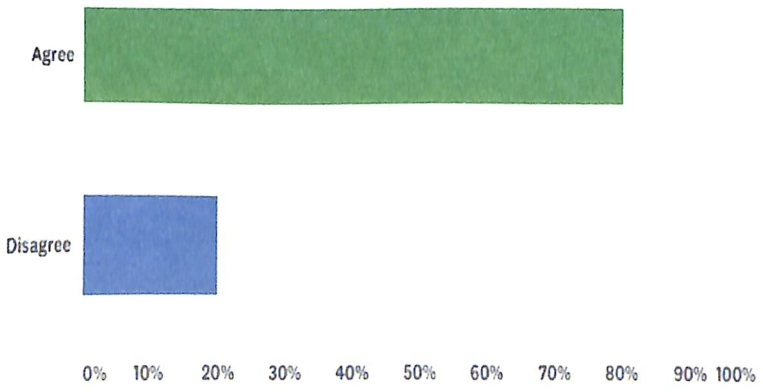
3. **Fig 3:** Joint Usage of Airspace



4. **Fig 4:** Usage of Airspace above FL 290

Q4 IAF operations generally entail flight levels up to 290 and on a specific occasion above that due to LFE or particular mission requirements. Airspace above FL290 may be made available to civil flights on conditions of transfer to civil area control centres.

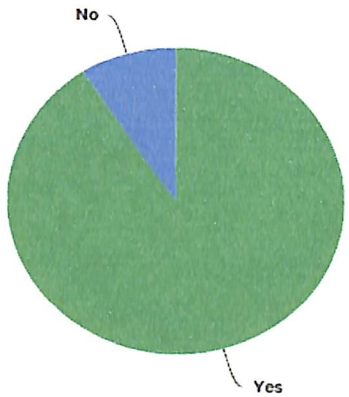
Answered: 136 Skipped: 3



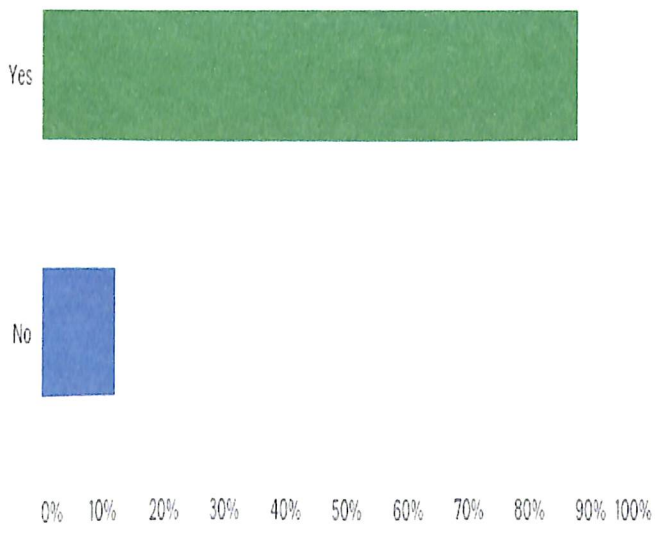
5. **Fig 5:** Flexible use of airspace justifiable or not

Q5 About 40% of Indian airspace comes under defence authorities and is restricted to civil aircraft movement. As a result, most of the navigational routes are not straight, and commercial flights have to circumvent the restricted areas thereby losing fuel and time while adding to carbon emission. In your opinion the flexible use of airspace by IAF and Civil users is justifiable?

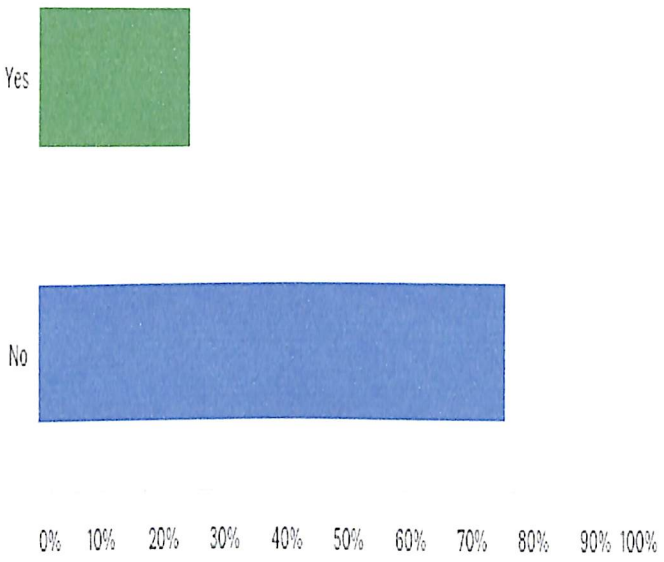
Answered: 139 Skipped: 0



6. **Fig 6:** Awareness of airspace structure in UK

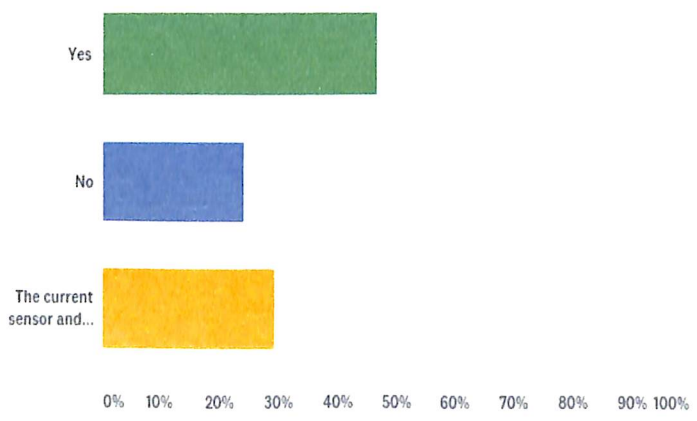


7. **Fig 7:** Effect on IAF's Operations



8. **Fig 8:** Selective Clearance of FUA Routes

Q8 Currently, IAF is not clearing the FUA (Conditional routes) proposals affecting routine training flying and clearing proposals of CDRs subjected to holidays and during late night hours. Do you think IAF is doing right?



EXECUTIVE SUMMARY/ABSTRACT

1. India's civil aviation sector is growing at a very fast rate. This is revealed in the double digit growth rates of passengers /freight and aircraft orders placed by Indian aircraft carriers. As of Jul 18, about 620 airplanes were operating in the fleet of scheduled Indian carriers. Investments of Rs 42000-45000 crores (US$ 5.99-6.41 billion) are estimated in India's airport substructure between FY 19-25. Presently, Indian airports are able to accommodate controlled movements of aircraft due to organization and procedural limitations leading to congestion, delays and wasteful burning of fuel by aircraft holding over airports pending permission to land. Indian aviation industry today needs few pragmatic and radical changes to not only boost the Indian economy but ensure safer skies by efficient airspace management in co-ordination with Indian Air Force.

2. Introduction of **Flexible Use of Airspace** (FUA) concept is based on the fundamental principle that airspace is one continuum to be allocated for use on a day-to-day basis to accommodate user requirements. With increased demand from both military and civil aviation sector the available airspace needs to be effectively utilized to enhance the airspace capacity and to facilitate the demands of both the sectors. The concept is based on the core principle of the airspace shared by all of its users, with flexible and temporary allocation of the airspace to the respective users.

3. Today the national economy and growth stresses elasticity in the airspace utilization for the operation of the civil flights, which is ever growing considering the incredible growth recorded in the civil aviation sector. FUA permits the airspace available with both military and civil users to be effectively utilized on sharing basis to gain optimum usage thereby enhancing its capacity and derive economic benefits to flights operating within a nation's airspace.

CHAPTER 1

INTRODUCTION

Overview

1. Airports are a very crucial commercial service for India. 30-40% of India's trade by value, and 90-95% of international travel to and from India, takes place through the medium of air using International Airports. India's civil aviation minister has already declared the start of an **"Air Travel Revolution"**. Presently, India has more than 20 international airports, 87 domestic airports and 28 civil enclaves, as well as more than 290 small airstrips. The modernization of all major airports has already been done after initiative of the civil aviation ministry way back in 2008 and plans to upgrade more number of airports is still in the process and plans of the aviation ministry.

2. At present, our airports are able to accommodate only constrained movements of aircraft due to infrastructure and procedural constraints leading to overcrowding, flight delays and wasteful burning of fuel by aircraft holding over airports awaiting permission to land. Indian aviation industry today needs few pragmatic and radical changes to not only boost the Indian economy but also to ensure safer skies by efficient airspace management in co-ordination with Indian Air Force.

3. With increased demand from both military and civil aviation sector the available airspace needs to be effectively utilized to enhance the airspace capacity and to facilitate the demands of both the sectors. This can be achieved by the introduction of **Flexible Use of Airspace (FUA)**. The concept is based on the core principle of the airspace shared by all of its users, with flexible and temporary allocation of the airspace to the respective users. FUA permits the airspace available with both military and civil users to be effectively utilized on sharing basis to gain optimum usage thereby enhancing its capacity and derive maximum economic benefits to flights operating within and outside a nation's airspace.

4. Indian Air Force is increasingly engaged in many air exercises and joint training activities. These specific air sorties require segregated airspace structures and generally do not happen on a daily basis. Post implementation of Flexible Use of Airspace concept (FUA), it is no longer practical to designate airspace as either civil or military. Therefore, it should be considered as one continuum and used flexibly, while any segregation should be of temporary nature. Consequently, specific military air operations may be executed within temporary segregated airspace structures that would be active only within specified time period and necessary vertical limits. In case of national airspace, it is postulated that there is a need for such airspace structure that would comply with a set of predetermined tactical requirements and would serve as temporary segregated area for military operations/training, regardless of mission type. While the application of the FUA Concept undoubtedly leads to a number of improvements related to flight efficiency of civil air traffic, which in this case may benefit from the increase in flight economy, it also brings an opposite impact in case a Temporary Segregated Area (TSA) is being activated wherein the civil airlines would have to follow a longer route. With this in mind, it is paramount that TSAs are designed in the most optimal way to mitigate the aforementioned effect.

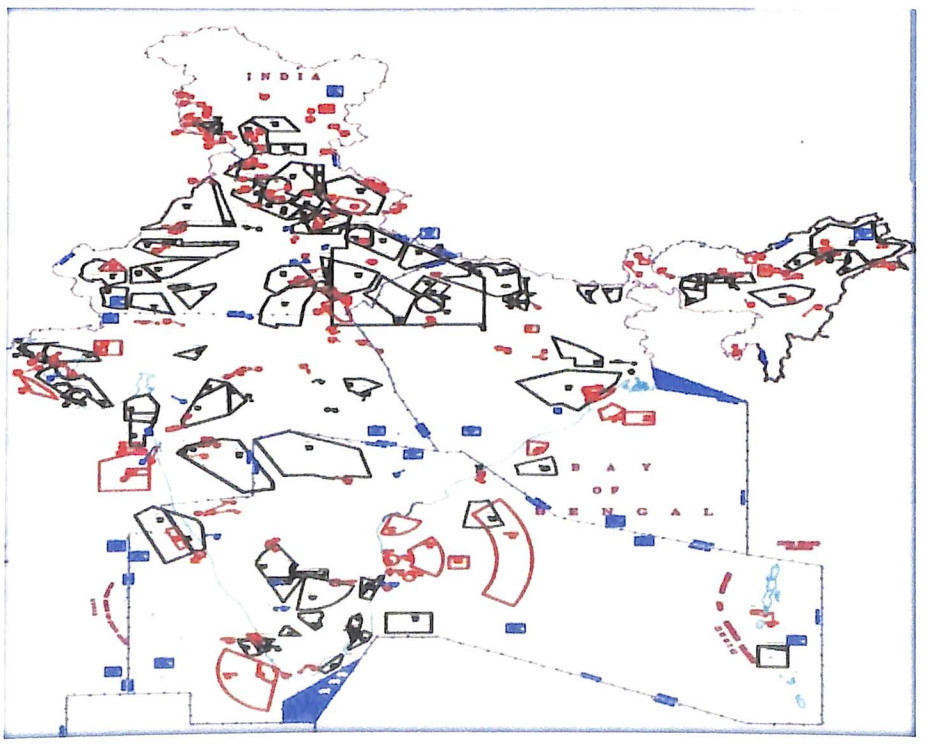
Background

5. The airspace is finite and users are increasing day by day. The civil aviation sector has witnessed remarkable growth in the last two decades. The climate control concerns and economic considerations compel us to utilize the airspace effectively so as to optimize the resources. IAF had the advantage of establishing restricted airspace for exclusive use and non-interference by civil aircraft in the exclusive airspace. The boom in the civil aviation sector compelled the GoI to implement and adopt the FUA model, which was successfully implemented by most developed countries around the world. The shortest route between two destinations is the need of the hour due to economic considerations. The economic savings per flight for a one minute flight time is approximately 1 lakh rupees. Thus theeconomic demand mandates to adopt the Flexible Use of Airspace and establishment of CDRs.

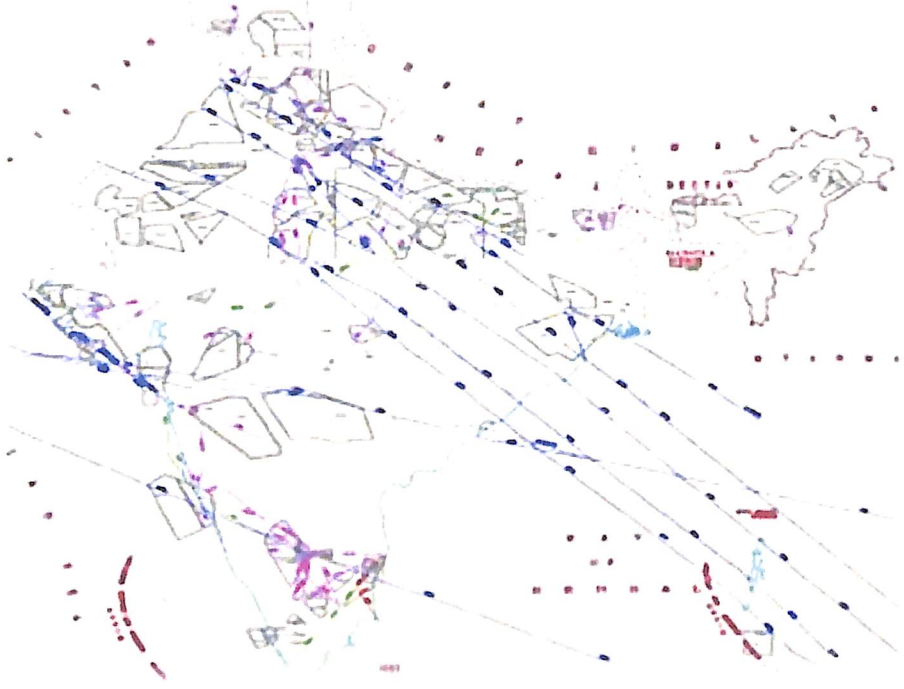
Statement of the Problem

6. The IAF flying is dynamic and less predictable compare to civil aviation scheduled flying due to various attributes involved in military training missions. The IAF mission depends on concurrent availability of many other resources like Airborne Warning and Control System (AWACS) or Flight Refueling Aircraft (FRA) etc. However due to adverse weather, aircraft serviceability or in-flight un-serviceability of critical function may lead to cancellation of planned mission or will be subject to inordinate delay. This unpredictability leads to underutilization of airspace which was blocked for military use. In addition, the IAF controlled airspace is underutilized or not used at all during Saturdays and Sundays at many places. The IAF airspace utilization at night is limited during peace time. These are the opportunity windows wherein civil flights may be permitted to transit through IAF controlled airspace to validate the concept of FUA. The existing special airspace structure and the ATS routes passing through such airspace are depicted in the sketch. The sketch indicates the amount of airspace which is required to be circumnavigated by civil airspace users over Indian airspace and the existing route structure transiting through special use airspace.

RESERVED AREAS OVER INDIAN AIRSPACE



ATS ROUTES PASSING TROUGH SPECIAL USE AIRSPACE



7. This dissertation seeks to study and suggest measures for an effective and efficient flexible use of airspace management model integrating both the civil and military airspace.

Purpose of the Study

8. Today the national economy and growth demands flexibility in the airspace utilization for the operation of the civil flights, which is ever increasing considering the tremendous growth registered in the civil aviation sector. At the same time there is also need to fulfill the demand of national security, where the use of airspace by the military needs to be fulfilled in the fast changing environment of air warfare. This is especially more relevant in these testing times after the Balakot air strikes on 27 Feb 19. Therefore, sharing of airspace on a need basis, by civil and military users is an urgent national requirement.

9. The IAF exercises require large airspace for a shorter duration; however predictability of adherence to the scheduled timing is always questioned by civil ATS agencies. This is primarily due to the various factors like aircraft with specific roles becoming unserviceable; weather is unfit for few pilots in a formation, non-availability of alternate aerodromes for possible diversion etc.

10. In view of such peculiarities, the objective of the research is to study and bring out that lot of research and thought would have to be applied for devising a structure which will not only suffice to the existing demands but also cater to the future demands that will only be ever increasing with time. Therefore this study intends to address the relevant issues of infrastructure, operations and training towards evolving a sound, practical and effective airspace management model for optimal utilization of national airspace.

Research Hypothesis

11. Establishment of Flexible Use of Airspace is not hindering the Indian Air Force operations and routine training flying.

Scope of the Study

12. Scope of this study is defined in the backdrop of the importance of a better airspace management model to cater for the ever increasing demand from the civil aviation sector. Various factors responsible for this perceived growth have been highlighted so as to put to rest any speculations that may arise in context of the recent economic crisis being faced by the country and the GDP growth being estimated at lowest since last two decades. Since the recommendations and suggestions of the study are very specific to the subject and need a clear understanding, the existing airspace structure (both in military as well as civil airspace) in the Indian skies has been explained. Along with this, the existing rules on the Flexible Use of Airspace (FUA) based on the guidelines of the International Civil Aviation Organization (ICAO) have also been touched upon briefly by giving examples of few countries following these models. The organization structure of Air

Defence setup and Director General of Civil Aviation (DGCA) have been left out to avoid bringing in extra details.

13. Implementation of any new concept has to be in a progressive and gradual manner while building up the required infrastructure and to a greater extent the experience and capabilities. Keeping this in mind, the suggested changes towards amalgamation of civil and military airspace have been divided into three different phases. Intricate details and SOPs for implementation of these phases have been avoided to keep the scope limited and only the guidelines have been laid out. Lastly the relevant recommendations from the Ajay Vikram Singh committee report (The high-level technical committee, headed by former Civil Aviation Secretary Ajay Prasad to suggest a Master Plan for next-generation futuristic Air Navigation Services), have been highlighted so as to bring out the required necessary changes to the existing aviation infrastructure for the implementation of Flexible use of airspace management concept.

Operational Terms

14. The special terms used in this dissertation are given below: -

(a)	AAI	--	Airport Authority of India
(b)	ADC	--	Air Defence Clearance
(c)	ADDC	--	Air Defence Direction Centre
(d)	ADIZ	--	Air Defence Identification Zone
(e)	ANS	--	Air Navigation Services
(f)	ASM	--	Air Space Management.
(g)	ATC	–	Air Traffic Control
(h)	ATS	--	Air Traffic Services
(i)	CDR	--	Conditional Routes
(j)	FIC	--	Flight Information Centre
(k)	FIR	--	Flight Information Region
(l)	FDI	--	Foreign Direct Investment
(m)	FNS	--	Future Navigation Services.

(n)	FUA	--	Flexible Use of Airspace.
(o)	GPS	--	Global Positioning System.
(p)	GAGAN	--	GPS-aided Geo Augmented Navigation
(q)	ICAO	--	International Civil Aviation Organization
(r)	JRATCC	--	Joint Regional Air Traffic Control Centre
(s)	MOA	--	Military Operating Area

Definitions and Abbreviations

15. The various definitions and abbreviations used in this dissertation are given below: -

(a) **Airspace Management Cell (AMC).** It is a joint civil/military cell responsible for the day-today management and temporary allocation of national airspace under the FUA concept.

(b) **Airspace Use Plan (AUP).** It is an ASM message of NOTAM status notifying the daily decision of an Airspace Management Cell on the temporary allocation of the airspace within its jurisdiction for a specific time period, by means of a standard message format.

(c) **Approved Agency (AA).** It is a unit, which has been authorized by an airspace user to deal with an Airspace Management Cell for airspace allocation and utilization matters.

(d) **Centralised Airspace Data Function (CADF).** It is an ASM function performed by the National AMC (N-AMC) for consolidating the AUPs / Updated Airspace Use Plan (UUPs) published by the Regional AMCs (R-AMC) and publishing them on the ATFM portal as electronic AUP (eAUP) / electronic UUP (eUUP).

(e) **Collaborative Decision-Making (CDM).**It is a process whereby all ATM decisions, except for tactical ATC decisions are based on the exchange

of all relevant information for transit operations between civilian and military parties.

(f) **Conditional Route (CDR).** It is a non-permanent ATS route or part of it that can be planned and used under special conditions.

(g) **General Air Traffic (GAT).** It encompasses all flights conducted in accordance with the rules and procedures of ICAO and/or the national civil aviation regulations and legislation.

(h) **Operational Air Traffic (OAT).** It encompasses all flights which do not comply with the provisions stated for GAT and for which rules and procedures have been specified by appropriate authorities.

(i) **Prior Coordination Airspace (PCA).** It is a portion of airspace of defined dimensions within which individual GAT is permitted to fly "off-route" only after prior co-ordination initiated by GAT controllers with OAT controllers.

(j) **Reduced Coordination Airspace (RCA).** It is a portion of airspace of defined dimensions within which GAT is permitted to fly "off-route" without requiring coordination between controllers.

(k) **Special Use Airspace (SUA).** It is the term used for airspace wherein activities must be confined because of their nature, or wherein limitations are imposed on aircraft operations that are not a part of those activities, or both. SUA is a generic term used to refer to Restricted Areas, Danger Areas, Prohibited Areas, TRA and TSA.

(l) **Temporary Reserved Area (TRA).** TRA is an airspace temporarily reserved and allocated for the specific use of a particular user during a determined period of time, through which other flights may pass with permission from Air Traffic Control (ATC).

(m) **Temporary Segregated Area (TSA).** It is an airspace temporarily reserved and allocated for the exclusive use of a specific user during a determined period of time, through which no other flights may pass.

(n) **Flight Information Region (FIR).** Airspace of defined dimensions within which flight information service and alerting service are provided.

(o) **NHLAPB.** Implementation of Flexible Use of Airspace is the responsibility of National High Level Airspace Policy Body (NHLAPB). NHLAPB is the high level body chaired by Secretary (Civil Aviation) and ex-officio members from Ministry of Defence (MoD), Indian Air Force (IAF), Indian Navy (IN), Indian Space Research Organization (ISRO), Directorate General of Civil Aviation (DGCA) and Airports Authority of India (AAI).

(p) **NAMAC**. National Airspace Management Advisory Committee (NAMAC) is a national airspace management body that is constituted to provide assistance and advice to the NHLAPB in formulating the national ASM policy and carry out the necessary strategic planning work, taking into account the requirements of civil and military airspace users and ATS providers.[1]

(q) **FUA Secretariat.** FUA Secretariat is a working level body residing within Directorate of Airspace Management of AAI, which carries out necessary facilitation for implementation for FUA concept.

Chapterization Schema

16. This study has been divided into **six** chapters. The **first** chapter introduces the recent growth that the Indian civil aviation sector has witnessed in recent times. It highlights the need for an urgent change in the present airspace management structure so as to give an impetus to the national economy and provide a safer airspace. The **second** chapter explicitly deals with review of literature in the aviation

[1] https://aim-india.aai.aero/eaip-v2//pdf/SUPs/AIPS_2017_12.pdf

sector of the industry and also includes various factors critical to the success of the study. The **third** chapter explains the development of civil aviation in India right from 1912 onwards. The development touches upon the rather slow and late entry of foreign airlines and the ensuing changes in aviation policies in brief. This chapter is specifically dedicated to various factors that will ensure and put an ever increasing demand on the need for an efficient airspace system due to the heightened air activity in coming times.

17. The concept of FUA has been explained in the **fourth** chapter that further leads us to the flexible use of airspace management systems existing in few foreign countries. This has been done so as to understand the factors leading to the selection of a particular model. To arrive at a futuristic Air Space Management (ASM) model, this chapter has been dedicated towards understanding of the existing airspace structure and ASM model in India. The **fifth** chapter brings out suggested Airspace Management in India after in depth analysis and interpretation of the results of the previous chapter. The final chapter, chapter **six**, forms the conclusion of the study, summing up the essence of what has been found during the research followed by the scope for future work.

CHAPTER 2

LITERATURE REVIEW

Review Area Broad

1. Various documents of International Civil Aviation Organization (ICAO) like Guidance for the Implementation of Flexible Use of Airspace, Civil Military Cooperation in Air Traffic Management (ATM), Global Air Navigation plan (Doc 9750), Manual Concerning Safety Measures Relating To Military Activities Potentially Hazardous To Civil Aircraft Operations (Doc 9554), Global Air Traffic Management Operational Concept (Doc 9854) and FUA manual of EUROCONTROL deal with the process and problems of FUA concept between highly developed aviation sectors and technologically advanced Air Forces like USAF and European Union. Analysis of FUA and (Conditional Routes) CDRs implications on national economy and environmental gains in terms of reduced emission was undertaken by many countries including India.

2. The Global Air Navigation Plan (Doc 9750) has as a final goal the achievement of an integrated, harmonized and globally interoperable Air Traffic Management (ATM) system. ICAO Annexure 2 - Rules of the Air, contains all rules concerning flight safety and aircraft maneuvering within the scope of the Article 12 of the Convention of ICAO, and provisions for coordination with military authorities for reasons of integrity and territorial sovereignty of a State, whereas ICAO Annexure 11 - Air Traffic Services, contains provisions concerning the need to coordinate with military authorities or units of the state, mainly to the extent the State military aircraft activities are affecting civil aircraft operations and vice versa.

3. In addition, the Procedures for Air Navigation Services - Air Traffic Management (PANS- ATM, Doc. 4444) contain all procedures applicable to other in-flight contingencies, such as lost or unidentified aircraft, that require coordination with military authorities, and describe procedures for the implementation of special military operations. ICAO CIR- 330 states that "each Contracting State shall require Air Traffic Service Providers operating in that State to establish and implement

appropriate security provisions to meet the requirement of the national security requirements. A review of ICAO definitions in the PANS-ATM (Doc-4444) and a review of expectations for security in the ATM Operational Concept provide the foundation for understanding the meaning of ATM security."

4. Information on coordination requirements between military units and air traffic services can also be found in the Manual concerning safety measures relating to military activities potentially hazardous to civil aircraft operations (Doc 9554) and in the Air traffic services planning manual (Doc 9426). Arrangements shall be made to permit information relevant to the safe and expeditious conduct of flights of civil aircraft to be promptly exchanged between air traffic service units and appropriate military units. In order to eliminate or reduce the need for interceptions, air traffic services authorities shall designate any areas or routes where the requirements of ICAO Annexure 2. This is in accordance with ICAO Doc 9554 (Manual Concerning Safety Measures Relating to Military Activities Potentially Hazardous to Civil Aircraft Operations).

5. The ICAO Global Air Traffic Management Operational Concept (Doc 9854) describes the services required to operate the global air traffic system in the near future and beyond, and lists the requirements to provide more flexibility for users, maximize efficiency, and increase system capacity, while improving safety. Integral parts of these elements are interoperability and military system operations.

6. In response to the agreements reached at the 2009 Global air traffic management forum on civil-military cooperation, ICAO and civil and military experts developed Circular 330-AN/189, which contains examples of good practices in civil-military cooperation and recognizes that growing civil air traffic and military air missions would benefit significantly from a more flexible use of airspace, and recommends and provides guidance on best practices in civil-military cooperation that could be adopted by States.

Review Area Narrow

7. Dr. Nagesh Nayak on 27 Mar 12 has said that "Airline delays lead to a tremendous loss of time and resources and cost billions of dollars every year in the United States (U.S.)."

8. S. Aneeka on Jan 2007 has said that "Arrival flights tend to spend long waiting times at holding stacks if the arrival airport is congested. Here, a case study was conducted for the flights arriving at Changi Airport. This study could be considered as an application of the Extended Arrival Management (E-AMAN) technique, which is proven to result in considerable fuel savings and more efficient management of delays."

9. Arnab Majumdar on Sep 1994 has said that "The air traffic control (ATC) system over Europe faces increasing pressure every year, leading to frustrating delays, and threatening the potential gains from liberalization of Europe's skies. The congestion of the aerial corridors over Europe is considered in terms of the factors hampering the effective use of the skies for civil aviation. The solutions and institutional frameworks offered to overcome the problem are discussed, together with the progress made so far."

Critical Factors

10. The Ajay Prasad committee was constituted by GOI to find out the need of FUA and to propose an action plan to implement the same. Literature available is studied in depth to provide insight into the problem of requirement for an effective and efficient flexible use of airspace management model integrating both the civil and military airspace.

11. As of now, the establishment of CDRs is concurred by IAF HQ after a detailed study by all the stake holders with regard to effect of route structure on training and operations. The conditions for transfer of airspace from IAF ATS unit to civil ATS unit and vice versa are explicitly mentioned in the MOU.

Summary

12. The Ajay Prasad Committee report states "The airspace of a nation is a finite asset, which is used for the civil and military flights together or individually. Today the national economy demands flexibility in the airspace utilization for the operation of the civil flights depending on their requirement, which is ever increasing with the growth registered in the civil aviation sector. At the same time there is also need to fulfill the demand of national security, where the use of airspace by the military needs to be fulfilled in the fast changing environment of air warfare. Therefore, sharing of airspace on a need basis, by civil and military users is an urgent national requirement". The Ajay Prasad Committee as part of its recommendation has stated that "the restricted airspace would continue with the Defence.

13. The flexible use of airspace concept would imply that the size of airspace would vary on as required basis" and "Standard Operating Procedures (SOPs) for managing these changes would be worked out jointly".

CHAPTER 3

RESEARCH DESIGN, METHODOLOGY AND PLAN

DATA SOURCES

1. The research has been designed primarily around the review of the existing literature. The subject has gained prominence only in the last decade or so, and hence the study material is confined primarily to this time frame. Majority of the relevant books do not form a part of the NDA, Khadakwasla Pune library and have been referred to from the various Air Force manuals and the Air Information Publications. Contemporary insights on procedural and technological growth were gleaned from military journals, yearbooks and internet. Update on existing airspace management models of other countries were referred to from the Internet and discussed with the foreign officers at the NDA, Khadakwasla Pune on instructional duty.

2. In addition, it is intended to do the research by adopting the quantitative research method especially by analyzing the opinions rendered by IAF operators, who are operating in airspace where the TSAs/TRAs and CDRs have been established. The material and information required for the same has been gathered from FUA Manual Version 1, consultations from Directorate of ATS Air HQ (VB), Airport Authority of India open source documents and discussions with airspace users.

3. Since most aspects of the topic are subjective in nature and do not lend themselves to objective quantification, they were realized through a systematic qualitative evaluation of experiences and their context. To collect the qualitative data, inputs were taken from the qualified staff at Air HQ (Vayu Bhawan, Delhi), Aircrew Examining Board (Indian Air Force) and officers from the Air Traffic Services and Navigation branch presently posted at NDA, Khadakwasla Pune. Details of publications and material referred to are placed at the Bibliography.

RESEARCH DESIGN

Development of Civil Aviation Sector in India

4. This was with the opening of first domestic air route between Karachi and Delhi by the Indian State Air services in collaboration with the Imperial Airways, UK, though it was a mere extension of London-Karachi flight of the later airline. Three years later, the first Indian airline, Tata Sons Ltd., started a regular airmail service between Karachi and Madras (now named Chennai) without any assistance or any kind of patronage from the government.[1]

5. At the time of independence, the number of air transport companies, which were operating within and beyond the frontiers of the company, carrying both air cargo and passengers, was nine. These airlines were Tata Airlines, Indian National Airways, Air service of India, Deccan Airways, Ambica Airways, Bharat Airways and the Mistry Airways.[2]

6. In early 1948, a joint sector company, Air India International Ltd., was established by the Government of India and Air India (earlier Tata Airline) with a capital of Rs 2.5 crore. Its first flight took off on June 8, 1948 on the Mumbai (erstwhile Bombay)-London air route. The joint venture was headed by J.R.D. Tata, a visionary who had founded the first India airline in 1932 and he piloted its inaugural flight himself.[3]

Open-Sky Policy

7. Foreign airlines carrying international passenger traffic to and from India existed long before independence. The Open-sky policy came in April 1990. The policy allowed

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[1] https://shodhganga.inflibnet.ac.in/bitstream/10603/197942/8/08_chapter1.pdf
[2] https://shodhganga.inflibnet.ac.in/bitstream/10603/42996/8/08_chapter3.pdf
[3] https://cdn.eeweb.com/projects/member-projects/Project-on-JAVA-in-Indian-Airlines-1295662725.pdf

air taxi- operators to operate flights from any airport, both on a charter and a non-charter basis and to decide their own flight schedules, cargo and passenger fares. The operators were, however, required to use aircraft with a minimum of 15 seats and conform to the prescribed rules. In 1990, the private air taxi-operators carried 15,000 passengers. This number increased to 4.1 lakh in 1992, 29.2 lakh in 1993, 36 lakh in 1994 and 48.9 lakh in 1995. In 1996, private air taxi operators carried 49.08 lakh passengers which amounted to a 41.14 per cent share in the domestic air passenger traffic. Seven operators viz NEPC Airlines, Skyline NEPC, Jet Air, Archana Airways, Sahara India Airlines, Modiluft and East West Airlines have since acquired the status of scheduled airlines. Besides this there were 22 nonscheduled private operators and 34 private operators holding no-objection certificate in 1996. The number of plus 120 category aircraft in the private sector was 34 and the total fleet strength was 75 in June, 1996. Two out of seven scheduled air taxi operators suspended their operations in 1996 because of the non-availability of aircraft.[4]

Development of Civil Aviation

8. The repeal of the Air Corporation Act from 01 March 1994 enabled private operators to provide air transport services. Six operators were given the status of scheduled operators on 01 February 1995. Currently there are fifteen international airports and 87 domestic airports in the country with 28 civilian enclaves for defence purposes.[5]

9. In late 2008, the Airport Authority of India had made plans to invest Rs 35,000 million for the construction and up gradation of airports. Budgetary support of Rs 485.50 million was allocated to the AAI in 1996-97. In August 1996, in a major policy decision,

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[4] https://cdn.eeweb.com/projects/member-projects/Project-on-JAVA-in-Indian-Airlines-1295662725.pdf
[5] Ibid

government allowed the private sector to set up air cargo complexes in a bid to ensure smooth movement of export cargo. Domestic and foreign investors including NRIs have been invited to participate in the development of infrastructure support at select airports. With a market share of 43% Indian airlines was the biggest player in aviation. Rs 24,710 million were marked for development of the civil aviation sector in the annual plan for 1997-98.[6]

Present Status

10. From just 5.1 million passengers in 1970, domestic and international air passenger traffic has grown to nearly 59 million passengers in 2004-05. International passenger traffic has grown from 16.6 million to 19.4 million and domestic traffic has grown from 32.08 million to 40.09 million from 2003-04 to 2004-05.[7] According to an ASSOCHAM (Associated Chambers of Commerce and Industry of India) Eco Pulse Survey, international passenger traffic out of India enjoyed a 17% growth, while domestic traffic witnessed a 24% year-on-year growth. Growth of domestic air traffic in the recent past has been ranked only second to China by growth analysts. Cargo traffic has grown from 979,000 tons (646,000 tons of international and 333,000 tons of domestic) in 2002-03 to 1.06 million tons of cargo (693,000 tons, international and 3.75,000, domestic) in 2003-04. More diverse businesses in non-metropolitan regions are creating new demand for air services. Airlines are bulking up on capacity -- 10 Indian carriers placed orders for 400 aircraft worth US$ 15 billion.[8]

11. The Indian market for international freight was expected to grow by nearly 10% annually over the next five years. Air cargo exports from India were expected to rise from the present 0.8 million tons to 2.4 million tons while domestic cargo to rise from 300,000 tons to over 1 million tons by 2010.[9]

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[6] https://shodhganga.inflibnet.ac.in/bitstream/10603/132598/8/08_chapter%201.pdf
[7] https://www.scribd.com/document/99383125/Aviation-Industry-in-India
[8] http://keic.mica-apps.net/wwwisis/MICA/Faculty/PAT/PRSI/iNF.doc
[9] https://www.scribd.com/document/99383125/Aviation-Industry-in-India

Future Growth

12. India's civil aviation sector is growing at a very fast rate. This is revealed in the double digit growth rates of passengers /freight and aircraft orders placed by Indian aircraft carriers. As of Jul 18, about 620 airplanes were operating in the fleet of scheduled Indian carriers. Investments of Rs 42000-45000 crores (US$ 5.99-6.41 billion) are estimated in India's airport substructure between FY 19-25.[10]

13. According to estimates, the present infrastructure can support a 20 per cent growth in passenger traffic and 10 per cent growth in cargo traffic. The need for improvement in infrastructure to meet these growing demands has been recognized and the Ministry of Civil Aviation estimates that there is a need for an investment of Rs. 260 to Rs. 360 billion.

Factors Guiding the Growth in Indian Aviation Industry

Geographical Location

14. Civil aviation has grown considerably all over the world. During last three years, there has been an unprecedented growth of civil aviation in India, which is likely to grow at the same rate in coming few years. Further, India is in the Centre of flights from Asia-Pacific region to Europe. As per the present estimates of ICAO, aviation in the Asia-Pacific region is growing and likely to grow further at the fastest rate in the world. All these flights pass through India. The density of civil aircraft in airspace for aviation is also growing accordingly.

Economic Policies

15. Indian Economic Policy was influenced by a Fabian-socialistic approach with

[10] https://www.ibef.org/industry/indian-airports-analysis-presentation

emphasis on protectionism, import substitution, state intervention in labor and financial markets, and central planning. The government had strict restrictive economic policies over the private sector participation, foreign trade and foreign direct investment. The first breakthrough came with Jawaharlal Nehru and statistician Prasanta Chandra Mahalanobis, who emphasized on more flexible economic policies involving both public and private sectors based on direct and indirect state intervention. However, India Economic Policy changed after 1980 with the removal of restrictions on capacity expansion for incumbents, price controls and reduction in corporate taxes. The revolutionary change came with the economic liberalization of 1991, undertaken by the then prime minister of India, Mr P. V. Narasimha Rao and the finance minister Shri Manmohan Singh. Considering the balance-of-payments crisis, they formulated a new set of economic policy in India, ending many public monopolies and allowing automatic approval of foreign direct investment in many sectors of the Indian economy.[11] All these policies were directed towards attracting more and more foreign investment thereby providing a positive impetus to the dwindling Indian economy at that time. The various Indian Economic Policies at present comprise of:-

(a) Civil Aviation Policy
(b) Foreign Direct Investment Policy
(c) Drug Policy
(d) Industrial Policy
(e) Broad Band Policy 2004
(f) National Electricity Policy
(g) New Telecom Policy 1999
(h) Foreign Trade Policy
(j) Exim Policy
(k) National Mineral policy
(l) Monetary and Credit Policy
(m) Non-Resident Indians(NRIS) Policy

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[11] https://business.mapsofindia.com/india-economy/policy.html

(n) Current Export-Import Policy

(o) Current Monetary And Credit Policy

(p) Indian Direct Investment In Joint Ventures And Wholly Owned Subsidiaries Abroad Policies And Procedures For External Commercial Borrowings

(q) Overseas Venture Capital Investment In India

16. India's mixed economy combines features of both capitalist market economy and the socialist planned economy, but has shifted more towards the former over the past decade. At present, the India Economic Policy has made India as one of the most prosperous economy of the developing world. Indian economy today is one of the most preferred destinations for the foreign direct investments with few sectors like real-estate sector inviting 100 % FDI.[12]

Aviation Policies

17. The government has been quite active in evolving a policy framework for development of the aviation sector in the country. Some of the most significant developments undertaken by the government include deregulation of the domestic airline markets, inviting private participation in the development of airport infrastructure and modernization of the air traffic system. The government has drafted a new Civil Aviation policy that aims at:-

a) Improving the development and regulation of civil aviation including the operation of air transport services to meet the needs of the people for safe, secure, regular, efficient and economic air transport.

b) Establishment of the Civil Aviation Authority.

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[12] https://business.mapsofindia.com/india-economy/policy.html

c) Continued adherence by India to the Chicago Convention, the Tokyo Convention, The Hague Convention and the Montreal Convention, including the Montreal Protocol.[13]

d) Adherence by India to the convention for unification of certain rules relating to international carriage by air, signed at Montreal on 28 May, 1999.

18. The other measures initiated by the government are as under:-

(a) The government allows up to 40 per cent foreign equity in domestic air carriers.

(b) Non-resident Indians and corporate bodies are allowed to hold up to 100 per cent equity in domestic air transport services.

(c) Over the last few years, there have also been significant changes in India's bilateral air services policy. Recognizing the need to enhance the availability of capacity for international traffic, the government has re-negotiated the existing bilateral agreements or has entered into fresh new bilateral agreements with a number of countries. Consequently, the capacity on international routes has gone up to approximately 3.3 million seats per annum.

(d) In addition, the government has allowed new points of call for foreign airlines and agreed to the utilization of the Indian landing entitlement in other countries by foreign carriers on mutually beneficial terms.

(e) For cargo operations, India has an open-skies policy. For chartered flights, the government has been gradually liberalizing the conditions for allowing such flights at a larger number of airports. Except for popular destinations like Goa,

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[13] Dipender Sinha. Deregulation & Liberalisation of the Airline Industry. 2001, p.33

Jaipur, Agra, etc., charters are now permitted to fly Indian nationals as well, to other tourist destinations.

(f) The government has allowed 100 per cent FDI in airports. FDI up to 74 per cent are approved through the automatic route.[14]

Investment & Trade Activity

19. India's exports were stagnant for the first 15 years after independence, due to the predominance of tea, jute and cotton manufactures, demand for which was generally inelastic. Imports in the same period consisted predominantly of machinery, equipment and raw materials, due to nascent industrialization. Since liberalization, the value of India's international trade has become more broad-based and has risen to Rs. 63,080,109 crores in 2003–04 from Rs.1,250 crores in 1950–51.India's major trading partners are China, the US, the UAE, the UK, Japan and the EU. The exports during April 2007 were $12.31 billion up by 16% and import were $17.68 billion with an increase of 18.06% over the previous year.[15]

20. India is fourteenth in the world in factory output. However, about one-third of the industrial labor force is engaged in simple household manufacturing only. Economic reforms brought foreign competition, led to privatization of certain public sector industries, opened up sectors hitherto reserved for the public sector and led to an expansion in the production of fast-moving consumer goods (FMCG).[16] It has since handled the change by squeezing costs, revamping management, focusing on designing new products and relying on low labor costs and technology. 34 Indian companies have been listed in the Forbes Global 2000 ranking for 2008.

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14 https://economictimes.indiatimes.com/industry/transportation/airlines-/-aviation/government-allows-100-foreign-direct-investment-in-airlines/articleshow/52832214.cms?from=mdr

15 https://www.civilserviceindia.com/subject/Essay/working-for-global-economic-growth-and-stability-india-role.html

16 AN Sarkar . Enhancing Global Competetiveness: Advantage India.2009, p.246

Favourable Demographics

21. The Demographics of India are overall remarkably diverse. India's population of approximately 1.13 billion people (estimate for March 10, 2008) comprises approximately one-sixth of the world's population. India has more than two thousand ethnic groups, and every major religion is represented, as are four major families of languages (Indo-European, Dravidian, Austro-Asiatic and Tibeto-Burman languages).

22. Although most of the Indian workforce still earns its livelihood directly or indirectly through agriculture and manufacturing, high tech services are a growing sector and play an increasingly important role in India's economy.

Tourist destination

23. India's rich heritage and natural beauty are marketed to international leisure travellers. With ministry of tourism taking due interest the share of India in international tourist arrivals has increased progressively from 0.46% in 2004 to 0.49% in 2005 and further to an estimated 0.55% in 2007. Foreign Tourist Arrivals (FTAs) rose from 3.46 million in 2004 to estimated 5 million in 2007. Domestic tourism too has grown phenomenally over this period rising from 366.23 million in 2004 to an estimated 462 million in 2006.

24. Over 10 million **foreign tourists** arrived in **India** in 2017 compared to 8.89 million in 2016, representing a growth of 15.6%. Domestic **tourist** visits to all states and union territories numbered 1,036.35 million in 2012, an increase of 16.5% from 2011.[17]

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[17] https://en.wikipedia.org/wiki/Tourism_in_India

Concept of Flexible Use of Airspace Management

25. The civil and military are the prime users of the national airspace and under the existing system in majority of the countries the airspace is used by both in isolation from each other. However, with increased demand from both military and civil aviation sector the available airspace needs to be effectively utilized to enhance the airspace capacity and to facilitate the demands of both the sectors. This can be achieved by the introduction of **Flexible Use of Airspace (FUA)**. The concept is based on the core principle of the airspace shared by all of its users, with flexible and temporary allocation of the airspace to the respective users.

The Airspace Management (ASM) Objectives

26. The objective of ASM is to achieve the most efficient use of the airspace based on actual needs and, where possible, to avoid permanent airspace segregation. The need for improved ASM in Europe was recognized in the late 1980s when the continuing growth of aircraft movements exceeded the capacity of the ATS systems causing serious delays. From the ASM objectives the FUA concept was conceived and has now been successfully implemented in the form of EUROCONTROL in Europe.[18]

The FUA Management Concept

27. FUA permits the airspace available with both military and civil users to be effectively utilized on sharing basis to gain optimum usage thereby enhancing its capacity and derive economic benefits to flights operating within a nation's airspace. In this model a coordination procedure between the civil and the military authorities is required for transferring the airspace from one user to another i.e. military to civil and

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[18] https://www.eurocontrol.int/concept/advanced-flexible-use-airspace

vice versa, when not used by the user assigned with the responsibility of its control. The element of surveillance by the military authorities of the airspace and the traffic therein continues as per the existing system.

28. With the application of the Flexible Use of Airspace Concept (FUA), airspace is no longer designated as "Civil" or "Military" airspace, but considered as one continuum and allocated according to user requirements. The application of the FUA Concept ensures that any airspace segregation is temporary and based on real use for a specified time period.[19]

29. Some of the countries have already systems in place for Flexible Use of Airspace for optimum use by Civil and Military agencies. In India also, some initiatives have been taken both by the Indian Air Force and the Civil Aviation authorities to bring about effective civil-military coordination leading to flexible use of airspace. However, considering the present status of India's foreign relations with its neighboring countries cross border application of FUA seems to be a remote possibility.

Study of Flexible Use Of Airspace Management In Other Countries

Eurocontrol

30. Eurocontrol was created in 1960 for the express purpose of creating a single upper airspace over Europe by its six founding member states. This purpose was only partially fulfilled at the time - but the idea remained a tenacious one.[20] Over the last decade, air traffic has grown by more than 50%. Europe now has close to 8.5 million flights per year and up to 28,000 flights on busiest days. Even so, airspace capacity has been increased by 80% since 1990. These results are good but the growth of traffic is

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[19] https://www.skybrary.aero/index.php/Restricted_Area

[20] https://www.avionews.it/en/item/1091357-european-union-agreement-for-the-single-european-sky.html

set to continue. EUROCONTROL expects that today's traffic will have doubled by 2020. Current systems, with ongoing improvements, should be able to handle this increased load until the middle of the next decade. After that, more radical measures are called for in order to avoid serious congestion.

United Kingdom

31. UK follows the concept of EUROCONTROL or **total Civil Military integration**. Airspace is not designated as either military or civil airspace on permanent basis, but is considered as one continuum and used flexibly on day-to-day basis as per mutually drawn airspace utilization plan. NATIONAL AIR TRAFFIC SERVICES (NATS) and MoD provide joint and integrated ATS. Three levels of airspace management are followed as per the legislation on the guidelines of the Euro control concept:-[21]

(a) **Level I (Strategic).** National ASM Policy, Planning and Co-Ordination.

(b) **Level II (Pre-tactical).** The day to day management and the temporary allocation of airspace.

(c) **Level III (Tactical).** Real time activation, deactivation and re-allocation of airspace.

32. The flexible airspace structure followed in UK is based on the segregation of the entire airspace in various areas namely:-

(a) Temporary Segregated Areas (TSA)

(b) Temporary Reserved Areas (TRA)

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[21] http://www.ibneditore.it/wpcontent/uploads/_mat_online/scienze_nav_verde/ASM%20Handbook%20Ed3.pdf

(c) Conditional Routes (CDR)

33. TSA and TRA vary in dimensions based on type of military exercises and profiles. Conditional routes are provided as per the demand which is frozen 24 hrs in advance.

United States of America

34. The United States based on its geographic area and political structure has formally incorporated flexible use airspace for over 50 years. To accommodate military air traffic in the National Airspace System (NAS), the military requirements are divided into two categories:-

(a) Operations that could be hazardous to non-participation aircraft or activities on the ground; and

(b) Those that are not. Inherently hazardous operations are conducted in segregated airspace termed special use airspace (SUA); the term SUA and its applications are more commonly recognized by ICAO as flexible use of airspace (FUA).

35. In the United States flexible airspace has been incorporated and continually refined into the National Airspace System (NAS) for over 50 years. The Federal Aviation Administration (FAA) is an agency of the USA. The Federal Aviation Act of 1958 created the organization under the name "Federal Aviation Agency" and adopted the current name in 1967. The following points are the major highlights of FAA model compare to Indian FUA model:-

(a) The civil and military controllers are trained together in the USA. USA has established an extensive, complex network for civil/military ATM coordination and cooperation, which facilitates problem resolution at the appropriate level as required. The network operates effectively through the exchange and interaction

of personnel. For example, active-duty military representatives are assigned to all three FAA service centers. Military operations functions are performed at FAA ATC facilities, primarily Air Route Traffic Control Centers (ARTCCs). Similarly, FAA personnel are assigned as air traffic representatives (ATREPs) at selected military facilities, and FAA liaison personnel are assigned to select military Major Command Headquarters. The FAA also allows the United States Air Force (USAF) to assign a tower officer to ATC towers at joint use airports to observe and advise of possible ATC issues.

(b) The FAA has designated the System Operations Security (AJR-2) Office of the Air Traffic Organization (ATO) as the lead office to ensure effective partnering on ATM security issues with the Department of Homeland Security, Department of Defence and other key agencies involved in aviation security, national defence, homeland security, law enforcement, and emergency operations including disaster response. Key objectives include harmonizing defence and homeland security requirements with the safety and efficiency needs of the NAS. The scope of activities ranges from tactical operations to policy and strategic planning.

(c) The FAA shares radar data with the North American Aerospace Defence Command (NORAD). NORAD is the bi-national U.S-Canadian military organization responsible for the aerospace and maritime defence of the U.S. and Canada, to enable early warning of air threats.

(d) The DOD Policy Board on Federal Aviation (PBFA), chaired by the Assistant Secretary of Defence for Networks and Information Integration/Chief Information Officer (NII/DOD CIO) ensures effective partnering with the FAA on policy issues affecting all military services. The Secretary of the Air Force designates an Executive Director of the DOD PBFA who serves as the DOD liaison with the Department of Transportation and FAA on federal aviation and national airspace matters. The Executive Secretary also represents the DOD in dealing with international aviation. In addition, all branches of the armed services have

offices or agencies that jointly develop procedures with FAA counterparts. The USAF provides flight crews that operate jointly with FAA flight crews and aircraft to perform flight checks of navigation aids at airports in the U.S. and DOD facilities overseas where they perform air traffic management services. The USAF also provides a liaison at FAA Headquarters to work with FAA Flight Standards on inspection of charter aircraft used to transport military personnel.[22]

(e) The air defence requirements of important cities are looked after by USAF bases, where the air traffic controllers also undertake the tasks of interceptions. The air traffic controllers provide surveillance and interception service along with routine ATC functions. In India the separate Fighter Controllers are entrusted with this task. The weekly training requirement of 2 practice interceptions will also be executed by these controllers at these bases. However, the AD requirements of USA and India are not commensurate; since, Indian AD system has to be agile and watchful of two hostile neighbors.

(f) The approach control function is provided by the civil ATC approach control unit or Area Control centers in majority of the bases unlike in India.

36. It is apparent that, there exists a huge scope for optimum utilization of airspace over Indian airspace from the two case studies and analysis of Federal Aviation Airspace FUA model. The recently established AMC in Delhi shall play a vital role in coordinating such operations discussed in the above case study with AAI to maintain an orderly flow of traffic and optimum utilization of airspace to achieve the objectives of FUA.

37. Airspace management is carried out by the civil and military agencies in a common airspace with close co-ordination and the full control; however, the controlling agencies are separate and not a single entity at all. Unlike in UK, the airspace is defined

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[22] https://www.icao.int/APAC/Meetings/2012_CMC/CIR330_en.pdf

separately as Military and Civil. This airspace is shared by either of the agency with prior intimation and the controlling agency having been informed well in advance by a minimum of 24 hrs notice.

Australia

38. The airspace management structure in Australia is very similar to that of India, wherein both the civil and the military agencies have clearly defined airspace structure which is exclusive to them. There is however, little airspace close to the dual use airbase used jointly by both the agencies. The controlling agency even in these cases continues to be either civil or military and there are no joint control centers.

Existing Airspace Structure & Airspace Management in India

39. Presently India is following the **side by side model of Airspace Management** wherein civil and military organizations are operating independently with minimal co-ordination necessary for the safe conduct of flight operations. Airports are categorized as civil aerodromes, defence aerodromes and defence aerodromes with civil enclave. There are three categories of airspace in India, namely:-

(a) Civilian Airspace

(b) Restricted Airspace used by Defence

(c) Prohibited Airspace

40. The entire civil airspace has been divided into 4 FIRs namely Mumbai, Delhi, Chennai and Kolkata, (which has Guwahati as Sub FIR). There are 90 International and 111 Domestic ATS routes out of which 31 routes are RNP-10 routes. Entire airspace is

RVSM airspace.[23] Eleven Area Control Centers have been established at Mumbai, Delhi, Chennai, Kolkata, Hyderabad, Ahmedabad, Nagpur, Mangalore, Thiruvananthapuram, Guwahati and Varanasi, which are equipped with en-route radar (MSSR), for the provision of area control service. The aircraft are required to navigate on the designated ATS routes. Aircraft are required to navigate on these routes with the help of conventional ground based aids like VOR/DME and NDB due to which the width of these routes is much larger.

41. Identification of all flights in Indian airspace is the responsibility of IAF. In order to enable the Air Defence organization to keep a track of all friendly aircraft operating in vital areas and to take action against unidentified/hostile aircraft intruding in these areas, a system of air defence authorization for friendly aircraft has been introduced. This is achieved by dividing the vital areas of airspace into eight ADIZs (Air Defence Identification Zones). No flight, civil/military originating within ADIZs or entering an ADIZ is permitted without an Air Defence Clearance (ADC) number. The issuance of ADC is the responsibility of the concerned ADDCs (Air Defence Direction Centres).

42. Ministry of Civil Aviation manages the airspace for civil aviation and provides air traffic services through Airport Authority of India (AAI) for flights in civil airspace and operating at the civil aerodromes.[24] Indian Air Force manages restricted airspace for all defence aviation and provides air traffic services for flights operating through it. However, air traffic services at the defence aerodrome are provided by the respective defence wing e.g. Indian Navy provides air traffic services at Goa airport, which belongs to them but clearance to operate a civilian flight to Goa comes through Indian Air Force. In all cases the control will always lie with only one of these agencies though the services may be shared. The two examples are Palam airport controlled by AAI (Airport Authority of India) and the second is Pune controlled by the Indian Air Force.

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[23] https://www.civilaviation.gov.in/sites/default/files/Committee%20reports%2012.pdf

[24] http://content.icicidirect.com/mailimages/Airspace.htm

43. Defence authorities use restricted airspace for their own flights and exercises and are not required to inform the civilian side about the movement or timings of their flights, except while passing through the civilian airspace. Civilian flights are required to use only civil airspace and are not permitted to use defence airspace on regular basis, except on specific clearance from IAF/MoD.

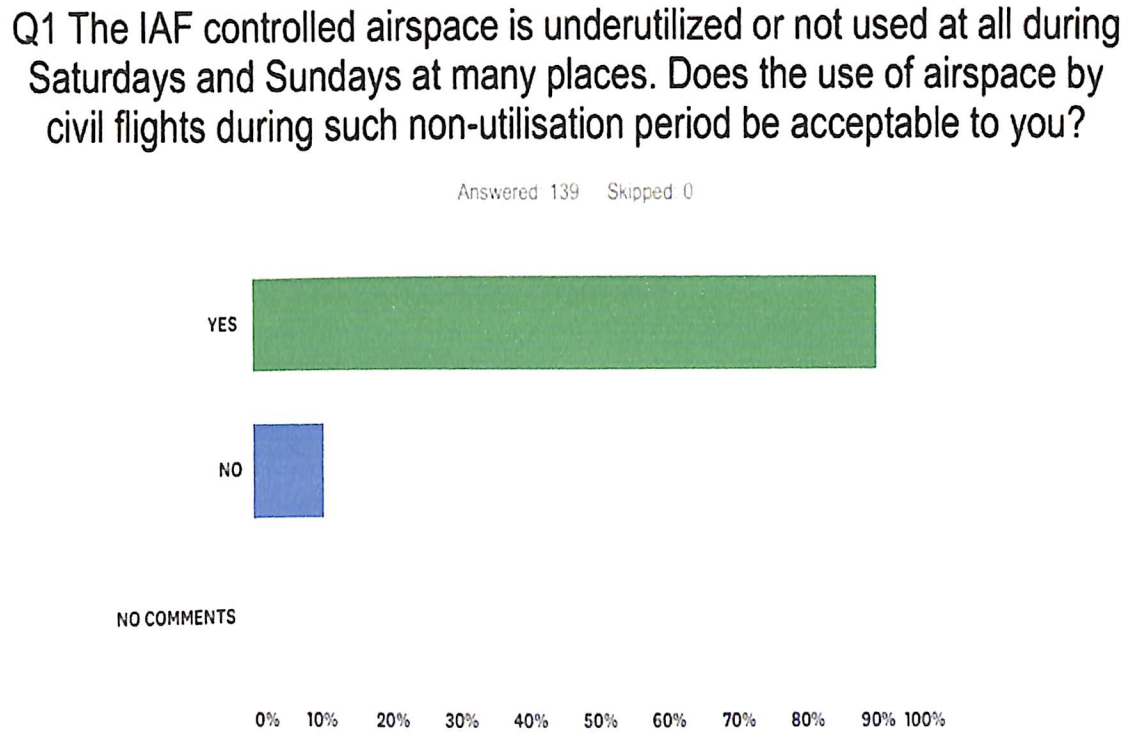
44. Avoidance of the defence airspace requires deviation of civilian flights from the preferred tracks and not only leads to increase in fuel consumption affecting the economics of flight. Also the present day military ac with enhanced ranges are unable to exploit their full combat capabilities due to restrictions on the use of civil airspace.

45. It has been generally agreed that no more rigid airspace structures will be established unless particularly important for national security. De-notification or realignment of under-utilized 'Danger' and 'Restricted' Areas under military is also being carried out.

SURVEY QUESTIONS

46. For the civil operators there is a need to strike a balance between commercial gains and national security in the use of airspace. Towards this response was sought from the Joint Director AAI desk at Director Ops ATS in the form of a questionnaire. The question was asked about AAI understanding the IAF concerns for denying a particular route due to operational constraints. To which JD ATS responded that AAI functionaries always appreciate the concerns of IAF. In addition, the response was sought from the user of airspace as well. This implies that the officers from the Air Force who are currently working in the Air Traffic Services and the Pilots. The final analysis of the survey with questionnaire is enumerated below to appreciate the general opinion of IAF airspace users on FUA and its implication on operations and training. The responses are graphically depicted with the help of bars and charts for better understanding.

Fig 1: Utilization of airspace on Holidays by Civil sector

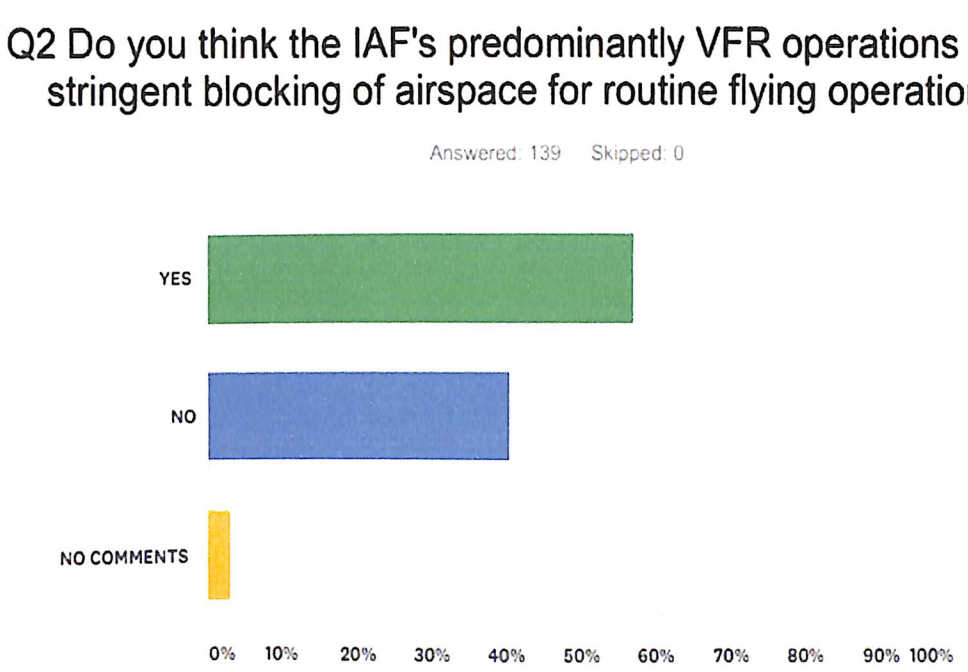


ANSWER CHOICES	RESPONSES	
YES	89.93%	125
NO	10.07%	14
NO COMMENTS	0.00%	0
TOTAL		139

Table 1: Responses on Utilization of airspace on Holidays by Civil sector

47. . Total of 89.93% respondents realized that during the holidays and non-flying days the airspace is not getting utilized at all. Thus opening up such airspace for civil use during those hours is completely acceptable and viable to them. It is pertinent to note that the awareness level on FUA amongst IAF operators is phenomenally increased and officers are willing to accommodate the airspace and aerodrome towards nation building.

Fig 2: Airspace blockage for IAF's VFR operations



ANSWER CHOICES	RESPONSES	
YES	56.83%	79
NO	40.29%	56
NO COMMENTS	2.88%	4
TOTAL		139

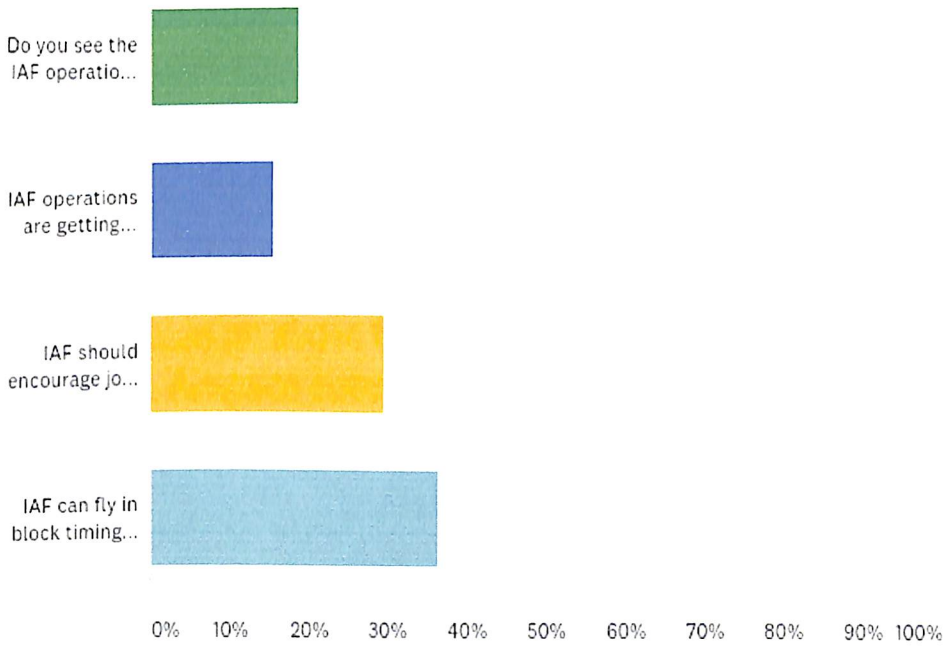
Table 2: Responses on Airspace blockage for IAF's VFR operations

48. The response for this question was surprising for the author, since 40 % of the sample data are in favor of undertaking VFR operations without blocking the airspace. This concept of operations is flown by RAF at United Kingdom (UK) in EUROCONTROL airspace and also followed at Federal Aviation Airspace. Most of the respondents had undergone training at UK and flown for a year in such environment. As of now the FUA concept has not envisaged to be of that level of interoperability. However, in future, country may have to explore such measures due to airspace being a finite resource and demand is on an exponential rise.

Fig 3: Joint Usage of Airspace

Q3: What is your opinion about the joint usage of Airspace?

Answered: 129 Skipped: 4

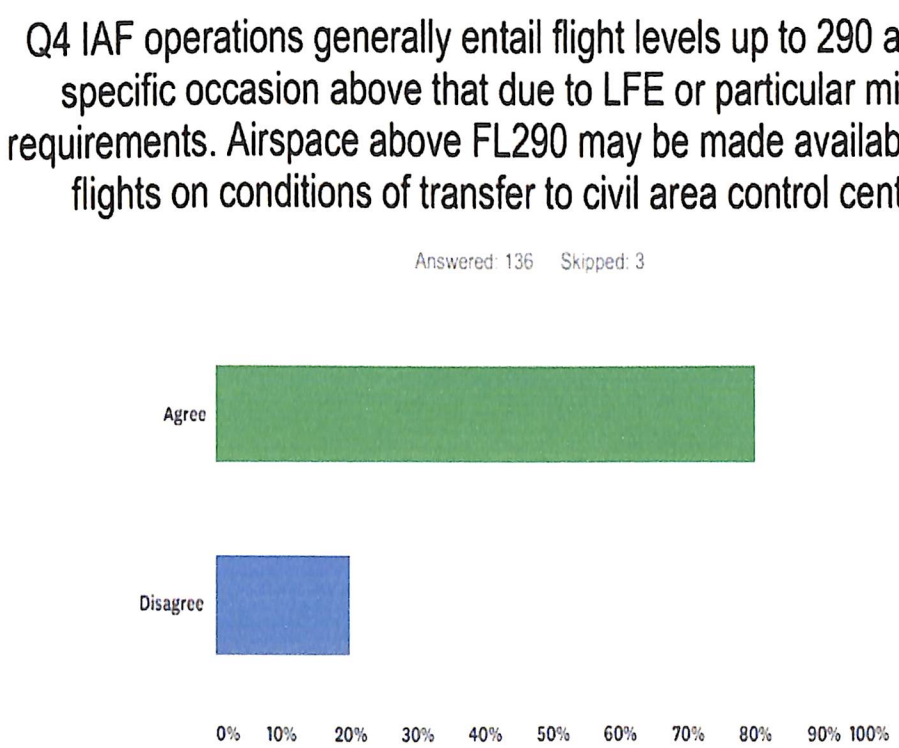


ANSWER CHOICES	RESPONSES	
Do you see the IAF operations are able to accommodate civil flights	18.60%	24
IAF operations are getting affected severely	15.50%	20
IAF should encourage joint user aerodromes to support economy of nation	29.46%	38
IAF can fly in block timings to optimise the airspace and aerodrome utilisation	36.43%	47
TOTAL		129

Table 3: Responses on Joint Usage of Airspace

49. It is incumbent upon the IAF to follow the global model of coexistence in the better interest of nation's economic growth. Dynamic coordination necessitates interoperability of CNS systems between the two stakeholders. Total of 84% respondents have favored the joint user aerodrome operation to support nation's economy. This is much more demanding from an IAF base than sharing of airspace when not being utilized by IAF aircraft. Total of 36.43% of the respondents agreed to fly in block timings for effective utilization of airspace.

Fig 4: Usage of Airspace above FL 290



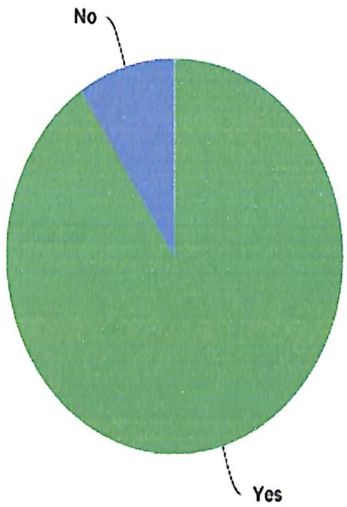
ANSWER CHOICES	RESPONSES	
Agree	80.15%	109
Disagree	19.85%	27
TOTAL		136

Table 4: Responses on Usage of Airspace above FL 290

Fig 5: Flexible use of airspace justifiable or not

Q5 About 40% of Indian airspace comes under defence authorities and is restricted to civil aircraft movement. As a result, most of the navigational routes are not straight, and commercial flights have to circumvent the restricted areas thereby losing fuel and time while adding to carbon emission. In your opinion the flexible use of airspace by IAF and Civil users is justifiable?

Answered: 139 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	90.65%	126
No	9.35%	13
TOTAL		139

Table 5: Responses on Flexible use of airspace justifiable or not

50. The answers sought for questions 4 and 5 clearly indicates that the current IAF holding of airspace can be utilized effectively to contribute towards national economy by allowing airlines to operate at higher levels. Survey also indicates that the non-utilization period of airspace by IAF can also be made available to airlines.

Fig 6: Awareness of airspace structure in UK

Q6: The flexible airspace structure followed in UK is based on the segregation of the entire airspace in various areas? Are you aware of the concept?

Answered: 131 Skipped: 2

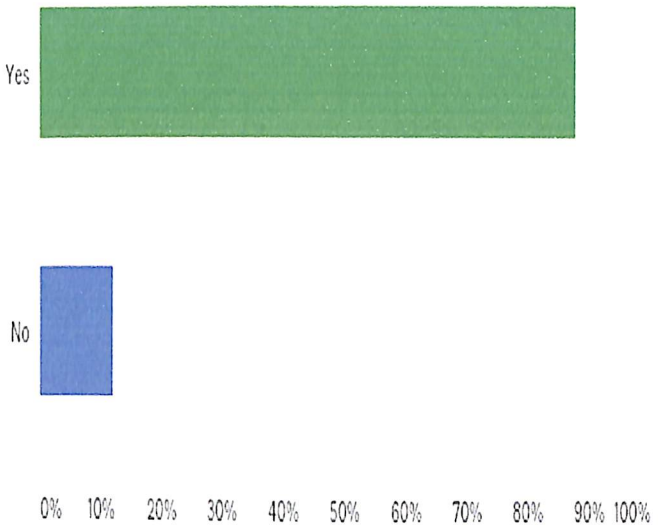


Fig 7: Effect on IAF's Operations

Q7: Do you think the utilization of ATS route running overhead military airspace during off working hours is likely to hamper IAF operations?

Answered: 131 Skipped: 2

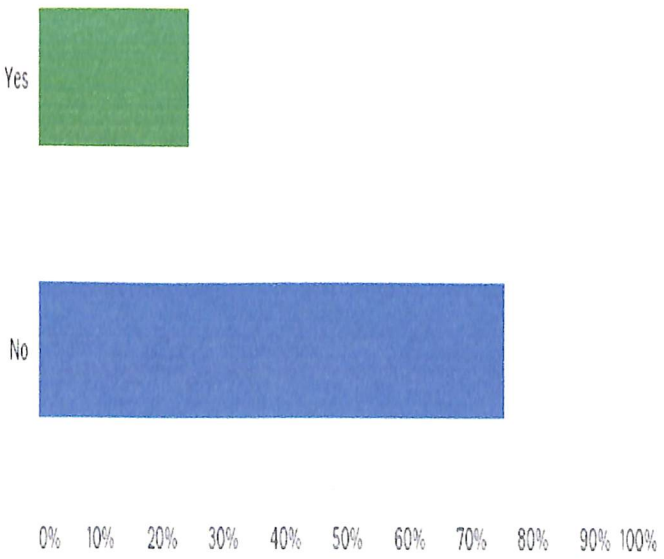
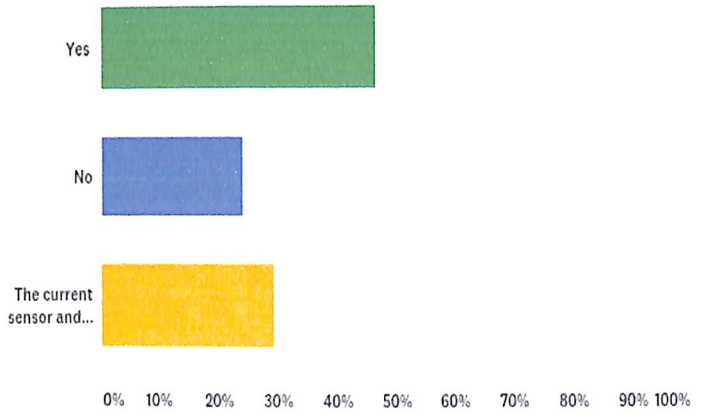


Fig 8: Selective Clearance of FUA Routes

Q8 Currently, IAF is not clearing the FUA (Conditional routes) proposals affecting routine training flying and clearing proposals of CDRs subjected to holidays and during late night hours. Do you think IAF is doing right?



ANSWER CHOICES	RESPONSES	
Yes	45.80%	60
No	24.43%	32
The current sensor and communication capabilities of IAF permit simultaneous use of airspace by IAF and civil	29.77%	39
TOTAL		131

Table 6: Responses on Selective Clearance of FUA Routes

51. 54.3% of respondents feel that during the hours other than night and holidays civil and IAF can undertake operations together in the same airspace. Also indicates that the current ATS capability of IAF is comparable with the civil capability.

CHAPTER 4

FINDINGS AND ANALYSIS

Analysis of FUA on IAF's Operations and Training

1. In the beginning due to the complexity involved in military air operations apprehensions existed regarding the freedom of fighter flying operations. Some of the major apprehensions were like losing the control of airspace and civil occupation of airspace will be permanent in nature and subsequently IAF's freedom of tactical navigation will get severely affected. However, some of the apprehensions are alleviated to the large extent by the joint effort of IAF and AAI officials on training the IAF operators on the FUA concepts at various organized command level workshops. Till now due to the availability of permanently reserved airspace structure, military users were able to continue operations based on their own ATS procedure which varied to allow operating freedom. With the introduction of FUA concept in India, permanently reserved airspaces will be gradually converted in to Temporary Segregated Airspaces (TSAs) and Temporary Reserved Airspaces (TRAs).

2. Towards this, research survey was conducted from the selected IAF airspace users in terms of pilots and controllers who are directly concerned with FUA. The target respondents were varied from senior functionaries of airspace managers in IAF and the operators from the field. The survey respondents were selectively chosen to address the hypothesis by selecting Flight Commanders (Flt Cdr) and Senior Air Traffic Control Officer (SATCO) of fighter aircraft bases. Also few of the respondents were selected from the airbases where CDRs were established since 2015 or CDR proposals are on the final stages for implementation. The designing of more number of CDRs as part of FUA implementation in India through military airspace has generated healthy discussion amongst the field operators and the civil airspace managers. This in turn educated most of the operators, who were involved in the decision cycle of establishment of CDRs. The research shows that some of the myths and misunderstandings got demystified and widespread understanding of FUA now exists in IAF.

3. **Alleviating Apprehensions Through Survey Results**

(a) Since airspace will be segregated as temporary airspace with fixed time of operation by civil aviation aircraft, flexibility of operations which was enjoyed by military users will reduce significantly. This was one of the reasons, which was profoundly argued by the IAF operators. However the AAI and IAF functionaries understood the flexibility offered by the FUA and CDRs very well. After due deliberation by all the stake holders of airspace, only at such feasible airspace the concurrence for establishment of TSAs/TRAs/CDRs was accorded by IAF. CDR2 and CDR 3 always offer the freedom to military flights to plan a mission in less than 24 hour period promulgate the non-availability of airspace due to military operations through AMCs. As far as the clearance for CDR1 is accorded by Air HQ with great diligence and deliberation with all the stake holders to alleviate the consequences of losing the freedom of operations.

(b) Another apprehension was that increasing number of CDRs through military airspace will require harmonization of military ATS procedures in tune with civil procedures and changes in aeronautical information services. As military airspaces are not classified, the type of service to be provided to civil aircraft using CDRs. The author had worked in airspace where the CDR1s have been in vogue before the implementation of FUA through 'Letters of Agreements' (LoAs) due to complexity of airspace structure and proximity of an international aerodrome. Author has the experience of working in a dense air traffic environment with civil and military flights operating together in places like Jodhpur, Pune and Jamnagar. The author's opinion is that today's scenario the capability of IAF ATS is no less than the Civil ATS setup. The training of controllers and the sensors (radar) availability with automation including the state of the art MAFI (Modernization of Airfield Infrastructure) equipment are at par with the AAI ATS. To substantiate the same in the research survey a specific question was framed and responses from 140 IAF officers were collected. The response from the survey clearly indicates that the

extant ATS capability and procedures are at par or comparable with civil ATS systems.

(c) One of the major apprehensions was regarding the operating freedom of military operators. This is a mandatory requirement to improve the training and battle readiness of the forces towards the security of a nation. In the Indian context this freedom of operation has been preserved through the establishment of permanently reserved airspace where military operators had uninhibited freedom of action to conduct their operations. However the new economic system compels nations to strike a balance between this uninhibited freedom of military operators and civil aviation requirements to look after both the economy and security of a nation. Majority of the current aircraft assets in IAF are of high endurance with adequate range and are airworthy. This feature will enhance the flexibility of operations and provide higher margin for training compare to the legacy fleets of IAF. As the need for optimal and flexible use of airspace increases, FUA implementation will be inevitable to support the economic development of a nation. So as military operators cannot retain their traditional operating freedom through rigid airspace structures there is a need to look for other avenues to retain the freedom of operation. A change in mindset, equipment profile and training will help the military operators in retaining their tactical freedom of operation while at the same time allow FUA implementation.

Analysis of IAF's Danger Area on Western Coast

4. On the western coast IAF operates an air to air range. The range is approximately 100 nm in length and about 40 nm wide. The range is published as 'danger area' and remains as a no fly zone 365X7. AAI has undertaken a study, since the airspace around the danger area is being extensively utilized by international air traffic of Mumbai and Ahmadabad. Due to the presence of danger area one of the ATS routes remains defunct and tactical routing offered by Ahmedabad area control is restricted. This entails circuitous routing with time penalty for civil traffic and also additional traffic load for the ATS units. The air to air range is utilized by IAF in a year for approximately 40 to 50 days only during the hours of broad daylight. By effecting

greater degree of coordination during the activation of range the airspace could be utilized optimally there by reducing the delay and saving the economy.

Analysis of IAF's Danger Area on Eastern Coast

5. On the eastern coast missile test firing is undertaken from an island. During the launch day the entire airspace is blocked due to the test firing and projection of missile flight path to very high level. However, the launch will take place only on complete satisfaction of pre-launch parameters and in many cases either the launch takes place with inordinate delay or gets cancelled. Dense traffic westbound from Eastern and South-Eastern nations is required to be diverted via a different route. The Kolkata area control center undergoes tremendous strain to de-conflict traffic in such situation to maintain an orderly flow of traffic. This could have been best avoided by higher degree of coordination to block the airspace only in case of launch.

Suggested Airspace Management Model for India

6. It is suggested that the civil/military ATS services should be independent on the point and should seek to promote the notion of integrated services contributing to FUAC (Flexible Use of Airspace Control), where safety and efficiency are enhanced through shared understanding and agreement on common principles and standards for the delivery of services. The objectives of the suggested model are as follows:-

(a) To maintain and enhance safety levels in the face of higher traffic densities.

(b) To provide ATC capacity to handle air traffic that would meet the forecasted demand without significant delays.

(c) To enable all airspace users to operate efficiently while accommodating both civil and military operators' needs.

(d) To provide the required ATM services in a cost-effective manner.

(e) To provide interoperability within adjacent airspaces.

(f) To adopt ICAO standards, specifications and functionalities that will standardize the ATM environment.

The Implementation Plan

7. The Plan has been considered in three parts namely, **Immediate, Medium Term** and **Long Term**. The Immediate Plan is based on **what we have today** and this involves the application of procedures, the processes and the capabilities. It serves to identify potential gaps to be filled immediately. The time frame should be not more than 2 years. The Medium Term Plan is based on the aspect **what we know today** and this involves the emerging procedures, the various processes and the capabilities. It serves to identify gap requirements and the action to be planned for implementation of the same. Time frame should be up to year 2025. The Long Term Plan is **based on future concepts** and involves new procedures and requirements based on Research.

Immediate Plan

8. To overcome the current impasse, setting up of Joint Regional Air Traffic Control Centers (JRATCC) needs to be initiated on an immediate basis. The JRATCC will have the representatives from both civil and military. Requirement of having foolproof and reliable communication network between all these centers will be a mandatory requirement. The various roles envisaged for these centers are:-

(a) Use of restricted airspace by civil aircraft when not in use by Indian Air Force.

(b) Activation / deactivation of conditional routes through military airspace.

(c) Suitable routing of IAF aircraft.

(d) Co-ordinate conduct of military air exercises in civil airspace.

(e) Sharing of flight information, surveillance data and provide assistance in SAR.

(f) Co-ordinate use of civil aerodromes by Indian Air Force as required.

(g) Co-ordinate operations of civil flights to/from IAF airfields.

Medium Term Plan

9. This plan envisaged to be operational by 2012 will involve three steps namely:-

(a) **Step 1.** Members of the rank of Joint secretaries from the Ministry of Civil Aviation, Defence, DGCA, AAI, IAF and other concerned service headquarters will get together so as to formulate the policies for implementation of under mentioned functions:

(i) Develop model 'Civil-Military' agreement and necessary amendments from time to time.

(ii) Prepare policy papers and perspective plans for Flexi-Use of Airspace.

(iii) Identify areas for flexible use of airspace and periodical review.

(iv) Evaluate new ATS routes through restricted airspace.

(v) Consider civil airspace requirements for military use.

(b) **Step 2.** Director level officials from the ministries of defence, civil aviation and specialists from DGCA, AAI and Service Headquarters will work together so as to evolve the operational modalities namely:-

(i) Implement decisions taken at level 1, formalizing agreements between civil and military authorities.

(ii) Work out the methodology for management of airspace and SOPs.

(iii) Monitor implementation of co-ordination procedures and review on need basis.

(iv) Assess and recommend the basic requirements of infrastructure and integrated technology.

(c) **Step 3.** At tactical level Joint Regional Air Traffic Coordination Centres (JRATCC) should be formed alongside the Area Control Centers (ACCs), which will meet day-to-day functional requirements of all the users namely:-

(i) Coordinate temporary reservation of airspace.

(ii) Activate/deactivate conditional routes.

(iii) Ensure smooth transfer of airspace from one user agency to another as per SOPs.

(iv) Monitor and co-ordinate any operational problem faced by the involved units.

Long Term Plan

10. The long term plan will take shape based upon varying factors like the air traffic density, technological advancement and the level of synergy achieved. Needless to say the future in all probabilities will see a seamless sky with a single entity controlling both the civil as well as the military flights. Keeping this in mind the present set up needs to cater not only in the commonality of infrastructure but also the procedures.

Suggested Changes for FUA Application

11. Needless to say the concept of FUA would also entail a change in the manner the allied aviation sectors and activities operate. The suggested changes in various sectors are as discussed below:-

Communication

12. A shift from Voice Communication to Data Communication is envisaged. In future the digital voice may be used through communication satellite and finally voice may be retained as a back-up when complete data communication is used.

13. Aircraft Communication & Reporting System (ACARS) technology is being mainly used by the airlines and to some extent by ATS for DATIS and departure clearances. ACARS is an analogue technology and has industry standards, which would be replaced by digital technology using ICAO SARPs. It is unlikely that ACARS would be used in future.[1]

14. Aeronautical Telecommunication Network (ATN) would replace present AFTN systems, which are character-based communication whereas ATN is digital based

[1] https://www.aai.aero/hi/system/files/resources/ajay-prasad-comittee-report.pdf

communication technology and connects aircraft, ground-based network of airlines and ground-based network of ATS.[2]

Navigation

15. In future, satellite based navigation system complimented with Flight Management Systems would be used for navigating the aircraft. The ground based navigation equipment's like NDB, VOR/DME and ILS may be retained as a back-up for some time before being phased out. GAGAN would play an extremely important part in the future navigation systems.

Surveillance

16. Surveillance is primarily carried out through radars, which are very expensive. The upcoming technologies in surveillance are ADS-B and wide area networks and both can be used in combination to provide extended surveillance.[3]

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[2] https://www.aai.aero/hi/system/files/resources/ajay-prasad-comittee-report.pdf
[3] Ibid

CHAPTER 5

INTERPRETATION OF RESULTS

Interpretation of Results

1. The survey was carried out with varied experience and representing wide range of operators like fighter pilots, transport pilots, helicopter pilots, fighter controllers and ATC controllers of various bases of IAF. The questions are designed to obtain the responses in most direct form about the implications of FUA on IAF flying operations. The total of 140 respondents was selected based on their branch in IAF and the understanding of the FUA concept. The responses are presented in bars and chart form.

2. It is apparent from the responses that the apprehension of IAF is adequately addressed. The analysis of the responses clearly indicates that there is wide consensus amongst IAF personnel that judicious use of airspace is dire necessity. Implementation of FUA will de-congest the air traffic at the confluence of ATS routes and also directly contributes to national economy.

3. The effect of FUA on IAF flying operations is negligible and the concerns are adequately addressed by the Air HQ and AAI under the umbrella of NAMAC and NHLAPB.

Benefits of Flexible Use of Airspace

4. Airline operators save significant amount of fuel through shorter routing options on Conditional Routes (CDR) passing through military airspace. Use of CDR1 and CDR2 routes will result in additional advantage of flight planning which saves the "cost to carry fuel". India has published 2 CDR1, 9 CDR2 and 3 CDR3 routes, which has resulted in reduction of more than 625 nm of routes between the concerned airports.

5. Rough estimates show that even a humble reduction of 625 nm of distance due to creation of CDRs, a majority of which are available only on Sundays or on tactical basis, has resulted in an average saving of 115 tons of fuel per month. This has resulted in decreased carbon emission of 355 tons per month. A direct benefit of shorter routing of aircraft on CDRs is better 'Air Traffic Management' by ATS units.

6. Airspace capacity increases due to faster disposal of traffic along shorter routes. It will also enable more efficient performance of ATFM system, as multiple routing options will be available for better management of air delay. Shorter routing options, especially which provide flight planning advantage, also improve operational efficiency of airline operators by better fleet utilization and improved 'On Time Performance' (OTP).

7. Creation of flexible airspace structures such as TSA and TRA and allocating the TSA/TRA pre-tactically through AMC will result in reduced occupation of airspace by military. Rigid airspace structures such as 'Danger Areas' and 'Restricted Areas' are inaccessible to non-military aircraft either on permanent basis or as when activated through NOTAM. In both these cases, actual use of 'Danger Areas' and 'Restricted Areas' by military may be significantly less than the published information, as the decisions to activate the airspaces are taken much before the actual day of operation and hence the projected requirement may be significantly greater than the actual requirement.

8. Cost effectiveness of FUA may not always be tangible. Besides the obvious benefit of saving fuel by aircraft operators, there are other long-term benefits such as reduction in carbon footprint and reduction in cost of flying when airline operators accrue significant savings due to shorter routing options. For the military, availability of local flying areas nearer to the air bases, which hitherto would not have been possible due to presence of ATS routes, will reduce the cost of operations.

Recommendations after Analyses

9. Various measures that need to be undertaken for speedy and smooth implementation of the suggested airspace management model are given below as recommendations:-

(a) All the defence airports catering to regular civilian flights should also be standardized as per ICAO requirements with all the observational and communication facilities at par with civil airports.

(b) Provision of web-based meteorological briefing system may be made to enable user agencies to have direct access to weather information, including weather information of defence airports where civilian flights operate on regular basis.

(c) As a first step, upper airspace above 29,000 feet could be released for civil traffic in the presently defined restricted/danger airspace.

(d) To divert the planned civilian traffic and not to cause undue hardship to passengers, a notice of at least 24 hours would need to be given. The normal defence air traffic would continue to use the upper airspace above 29,000 feet along with the civilian air traffic as at present.

(e) IAF should review Restricted and Danger Areas expeditiously and suitable action be taken.

(f) Efforts should be made for synchronization of the ATM procedures for civil and military airspace which will lead for seamless sky and seamless transition from one sector to another sector.

(g) Efforts also should be made to provide a seamless sky through standardization of CNS facilities to meet both military and civil requirements.

(h) Need to train and utilize each other's services and facilities like MET & ICAO procedures.

(j) The Defence airports which are catering to civilian flights should also be standardized and be given all the observational and communication facilities at par with the civil airports.

(k) Integration of IAF/Navy communication with IMD system at Defence airports from where civilian flights operate and would be operating.

(l) IMD should ensure standardization and optimization of the manpower at the existing and future airports as per the classification, by the recruitment of qualified and suitably trained manpower.

Comparison of Results with Assumption (Hypothesis)

10. The statement of problem as discussed in chapter one was critically analyzed during the research and it was derived that the implementation of FUA had seen sufficient resistance from the special airspace users in the beginning. Through consultation and joint design of airspace a required degree of understanding of FUA exists between the IAF and civil airspace managers. IAF has permitted 14 CDRs in the restricted airspace with due deliberation with the field operators with regard to constraints of allowing such CDRs. During the research it was observed that existing CDRs or route structure created with MoUs between AAI and IAF ATS agencies does not hinder any of the IAF's operational or training flying. On the contrary the survey results shown that all such military airspace users understand the requirement of FUA and its implementation fully.

11. The only requirement for conduct of IAF level exercises is to coordinate at appropriate level in advance and timely notification to the other airspace users. Currently, such LFE exercises are conducted within the confines of restricted airspace in most of the cases which impinges restriction on fighter aircraft due to the size of LFE Box.

12. The survey result analysis as enumerated in the chapter five clearly indicates that the implementation of FUA is inevitable and the IAF operators understand the concerns. Thus the implications were studied by analyzing the various CDRs and TRAs/TSAs. It emerged that the hypothesis holds good and the use of IAF controlled airspace by civil aviation users as per the terms of conditions specified, does not impinge or hinder the IAF's operation or training flying.

13. The suggested Master Plan has been formulated keeping in mind the present infrastructure, technological support and the critical gaps in the ASM model. This plan like any other plan can be successful only if it is implemented and reviewed from time to time taking into consideration the users and aviation community requirements and advent of new technology. India should focus on technologies that increase/improve the efficiency, safety and the passenger capacity by:-

(a) Improving communications across airspace to facilitate inter-facility transfer and flow of air traffic.

(b) Accelerate application of satellite technology in navigation and surveillance to allow for more flexible routings and enhanced situational awareness.

(c) Implement integrated ATM automation systems nationwide to improve efficiency and realize maximum benefits of modern CNS systems.

CHAPTER 6

CONCLUSION AND SCOPE OF FUTURE WORK

1. Civil aviation has grown considerably all over the world. During last three years, there has been an unprecedented growth of civil aviation in India, which is likely to grow at the same rate in coming few years. Liberal Indian Economic policies and other innumerable factors mentioned earlier make India as one of the most favored nation for trade and other activities. Further, India is in the center of flights from Asia-Pacific region to Europe. As per the present estimates of ICAO, aviation in the Asia-Pacific region is growing and likely to grow further at the fastest rate in the world. All these flights pass through India. The density of civil aircraft in airspace for aviation is also growing accordingly.

2. This unprecedented growth demands that the Flexible Use of Airspace should be accepted as underline basis for optimizing the use of Indian airspace for meeting the needs of both military and civil aviation for the country, which has already been accepted by the Ministry of Defence and the Indian Air Force (IAF).

3. Effective civil/military co-operation will enhance the safety and effectiveness of the implementation of FUA. However, there must be clear understanding and agreement on the roles of the different parties involved, and an acknowledgement that flexibility and balance in its implementation are essential in order to allow the development of best practice, to take account of unique, national environments and to encourage the airspace to be used to the maximum extent possible.

4. The United Nations' International Civil Aviation Organization (ICAO) has proposed to freeze carbon emissions by the aviation industry at 2020 levels. This will require airlines to limit their emissions or offset them by buying carbon credits from environmental projects around the world. From India's perspective, Indian aviation is expected to maintain its high growth trajectory in air travel (domestic and international) and air cargo movements. Although the deal would be voluntary between 2021 and 2026, it will become mandatory from 2027 for the world's largest emitters. Hence, the government will need to take some innovative steps like

implementing FUA, to address the need to limit carbon dioxide emissions while not obstructing growth.

5. Managing the healthy growth of the aviation sector will require focus on transformational change in governance, technology, processes and people involved in air navigation services. Traditional methods of increasing capacity have reached their peak. Hence, new improved methods and concepts will be needed to maximize the existing capacity and increase it where possible. Lastly, adoption of flexible airspace would tremendously help in reducing greenhouse gas emissions over the longer run, which the government has agreed upon as per the Paris agreement.

SCOPE OF FUTURE WORK

6. The use of a common airspace design tool allowing the representation of the area and its display on the current traffic situation picture may be required. Therefore a study on common airspace design tool will benefit ICAO rules enforcement committees immensely.

7. There is an urgent need to identify valid solutions for interoperability between civil and military CNS/ATM systems at an early stage in their development and to define a migration path towards long-term avionics convergence and integration.

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QUESTIONNAIRE

Q1. The IAF controlled airspace is underutilized or not used at all during Saturdays and Sundays at many places. Does the use of airspace by civil flights during such non-utilization period be acceptable to you?

Q2. Do you think the IAF's predominantly VFR operations require stringent blocking of airspace for routine flying operations?

Q3. What is your opinion about the joint usage of Airspace?

Q4. IAF operations generally entail flight levels up to 290 and on a specific occasion above that due to LFE or particular mission requirements. Airspace above FL 290 may be made available to civil flights on conditions of transfer to civil area control centers?

Q5. About 40% of Indian airspace comes under defence authorities and is restricted to civil aircraft movement. As a result, most of the navigational routes are not straight, and commercial flights have to circumvent the restricted areas thereby losing fuel and time while adding to carbon emission. In your opinion the flexible use of airspace by IAF and Civil users is justifiable?

Q6. The flexible airspace structure followed in UK is based on the segregation of the entire airspace in various areas? Are you aware of the concept?

Q7. Do you think the utilization of ATS route running overhead military airspace during off working hours is likely to hamper IAF operations?

Q8. Currently, IAF is not clearing the FUA (Conditional Routes) proposals affecting routine training flying and clearing proposals of CDRs subjected to holidays and during late night hours. Do you think IAF is doing right?