

## **FUTURE OF AVIATION**

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## **ABSTRACT**

Mobility is the key to the wealth and well-being of postmodern societies – so is human creativity and aspiration. Looking into today's visions of the potential of aviation, there is just as much to learn about air transport today as there is about future mobility and transport.

The International Forum for Aviation Research (IFAR) brings together the world's aviation research organizations to foster the exchange of perspectives and identification of mutually beneficial collaboration opportunities. IFAR provided top level representatives of aviation research organizations with a distinguished forum for a discussing the future of aviation and mobility over the coming decades. During the past year IFAR members had the opportunity to consider the future of the air transport system as a vital part of the next generation of mobility and transport systems in a globalized world in the middle of this century.

This activity represents a unique opportunity for the most influential nations in global aeronautical research to offer views based on very different cultural and educational backgrounds. IFAR members have different perspectives and professional experiences, and many members have published future strategic visions for aviation. Accordingly, IFAR members are well qualified to discuss the aeronautical future from a wide variety of different perspectives.

The focus and level of ambition of individual IFAR member organizations is often captured in regional or national strategic research agendas. However, to date these various perspectives have not been commonly analyzed and discussed in a global context. Given the global nature of elements of the value chain of the air transport system, it proved beneficial to commonly look for predominantly (but not only) global solutions, areas of commonality and regional aspects to tackle the challenges of the future.

## **INTRODUCTION**

In various sessions IFAR has been sharing and discussing the respective long term visions for aviation (such as the next 20-30 years). In particular, members have exchanged their perspectives about key challenges and opportunities facing the civil air transportation industry, areas of related planned or potential research, and potential gaps where additional research might be needed. Comparing common themes and interests across these various visions of the future of aviation, IFAR members were invited to consider the impact of regional differences or unique attributes, socio-economic factors, cultural factors, etc., and the resulting influence on aviation-specific challenges and opportunities, as well as the complexity of mobility and transport systems more generally. This discussion of future air transport system perspectives laid the foundation for an extended discussion

of common themes, drawing on our multi-national background and presence of top researchers and managers. Eventually this discussion is intended to contribute to IFAR's future specific vision of aviation and to support the future IFAR work program.

Finally it must be noted that IFAR does not want to duplicate what others (including the IFAR members themselves) are already doing. IFAR will point out directions of research and education that will support aviation by taking broader look rather than only putting the focus on safer, lighter, cheaper and environmentally friendlier. Therefore our goal for a "future of aviation vision is not to generate a new and exhaustive set of future challenges, goals and technology roadmaps but eventually to assemble outstanding ideas and concepts or research avenues as for examples created by regional requirements of our members. However, we regard this as a continuous exercise such that the respective findings will be updated in regular intervals in order to account for the changing environment and new developments.

Concerning the technological approach IFAR initially concentrated on five Focus Areas which were generated as common denominator from various strategic documents by IFAR members. In detail they are:

- Climate change – a continuous challenge for aircraft development
- Management of operations at and around airports to improve efficiency and environmental impact (e.g. noise).
- Enable the use of alternative aviation fuels.
- Increase air transportation system performance to safely enable projected growth in system operations.
- Reduce the adverse impacts of weather on air traffic management decisions and operations.

The strategic analysis of global trends shows that there are three major mega drivers impacting global aviation. The first is concentrating on traditional measures of demand for mobility which are growing very rapidly due to the strong growth of developing economies and global urbanization. Secondly severe energy and climate issues are creating enormous affordability and sustainability challenges, and technology is a key player for developing solutions. The third mega driver can be summarized as technology convergence - resulting from revolutions in automation, information and communication technologies. This driver will enable opportunities for safety critical autonomous systems and other technologies to radically transform the aviation industry in the long term.

## **IFAR AND THE FUTURE OF AVIATION**

IFAR provides a venue to connect research organizations worldwide, to enable the information exchange on aviation research activities between its members, to facilitate opportunities for networking and creating partnerships and to coordinate views and make recommendations. IFAR should maintain a non-competitive research focus, and consider solutions to global technical challenges such as those pertaining to emissions, noise, security, safety and efficient operations, and steps to reduce the impact of aviation on climate and the environment. In this sense, ideas in support of the five focus areas are supposed to strengthen coordination and cooperation among IFAR members.

IFAR is in a unique position which naturally comes with responsibility. Leveraging the full potential of its members' impact IFAR is perfectly suited to lead the way ahead by high-level exchange with national and international policy makers and international organizations (e.g. ICAO), to contribute to definitions

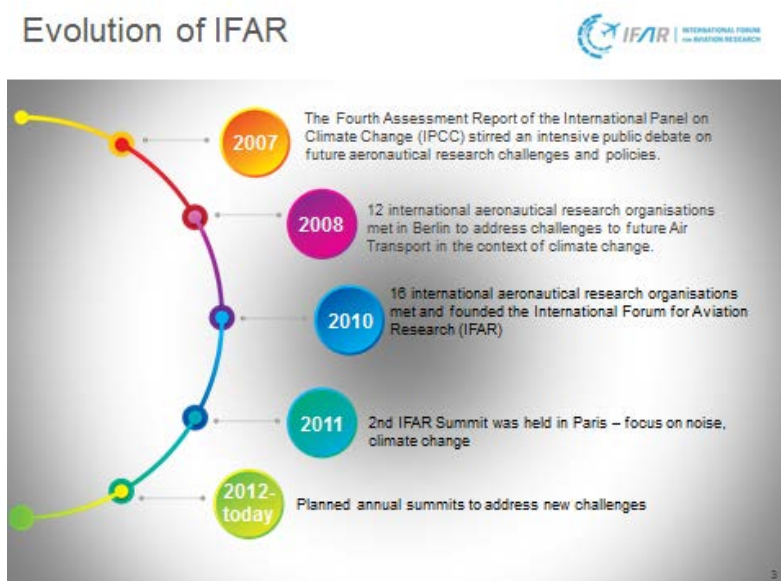
and standards (e.g. air traffic insertion of UAS), and to contribute to or even initiate reference data bases, for research and validation purposes.

IFAR eventually also aims at the realization of global human resources exchange and development. An important part of the future of aviation is attracting talents into aeronautics research not only from conventional aeronautical subjects but from other fields such as IT, robotics, nanotech, etc. There are compelling reasons to foster young researcher networking and collaboration across IFAR members. Aerospace is a global industry, requiring a solid understanding of global perspectives and capability to engage constructively with colleagues from other countries. Also the best minds from around the world are needed to find innovative solutions to the difficult problems facing the industry and last but not least collaboration among researchers using complementary approaches can generate better and more innovative results than each would have been able to accomplish alone.

The future of aviation can be built but certainly is difficult to predict. However, having the IFAR mission in mind the cornerstone is found in one single sentence Albert Einstein formulated: "Exchange of knowledge is essential for progress".

## ACKNOWLEDGEMENT

I wish to thank specifically Dr. Jaiwon Shin, NASA, and Dr. Kazuhiro Nakahashi, JAXA, for their engagement and leadership in the past two years as Chairman and Vice-Chairman of IFAR. All material presented here is based on various sessions with all the 26 IFAR members during the last five Summit meetings in Berlin, Paris, Nagoya, Moscow and Zhuhai.



## Statistics of IFAR



Currently **26** aviation research organizations from all over the world are members of IFAR  
 The current members represent **34,000** researchers working in aviation

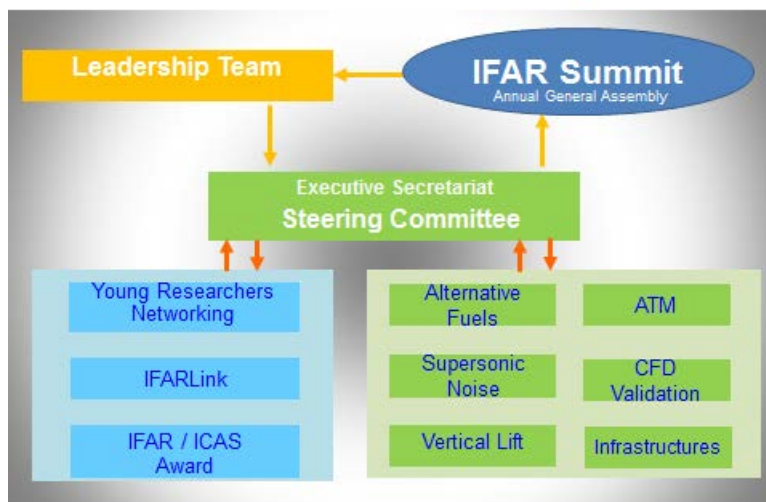


Membership in IFAR is open to national aviation research organizations, including universities active in aviation research, that are (1) non-profit, (2) owned or mainly funded by public governments, and (3) charged by the country or countries in which they are located to conduct such research activities on their behalf. One organization per country is accepted for membership.

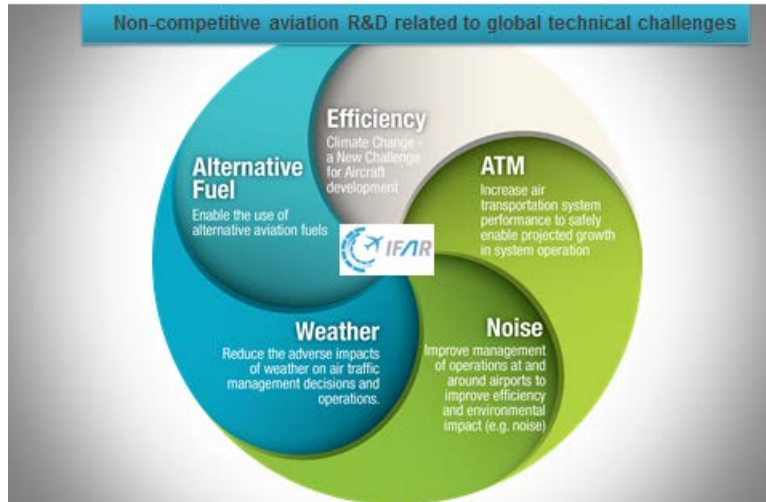
## Objectives of IFAR



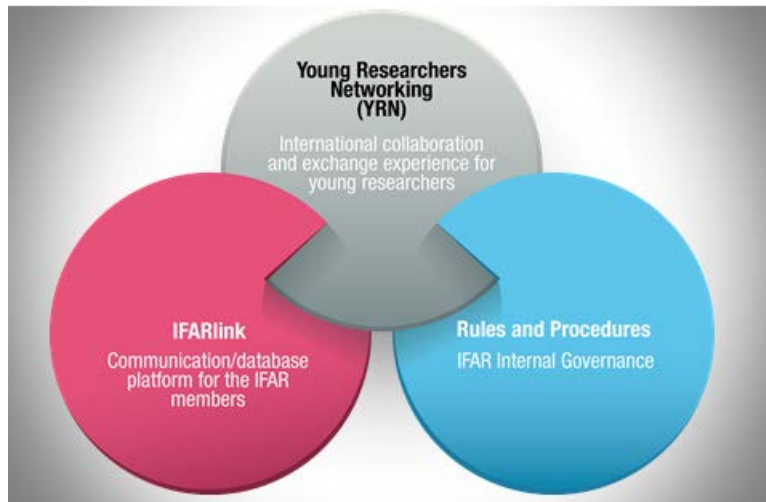
## IFAR Ways of Working



## IFAR Focus Areas



## IFAR Support Activity



## Young Researchers Development



- Young Researchers Network
- Young Researchers Conference
- Virtual Conference
- ICAS-IFAR Award

Young Researchers Conference 2014

Virtual Conference

ICAS-IFAR Award

ICAS IFAR



## Technical Cooperation



### Alternative Aviation Fuels

May 2014 – ACCESS II Campaign  
@ Armstrong Flight Research Center



July 2013 – WG Launch meeting in  
Washington DC

#### Effects of alternative fuels

on aircraft engine performance, emissions,  
and aircraft-generated contrails at altitude. Static ground tests and flight campaign  
to measure using a NASA DC-8 with DLR Falcon

## Technical Cooperation



### Air Traffic Management

May 2014 – WG Launch meeting in Berlin

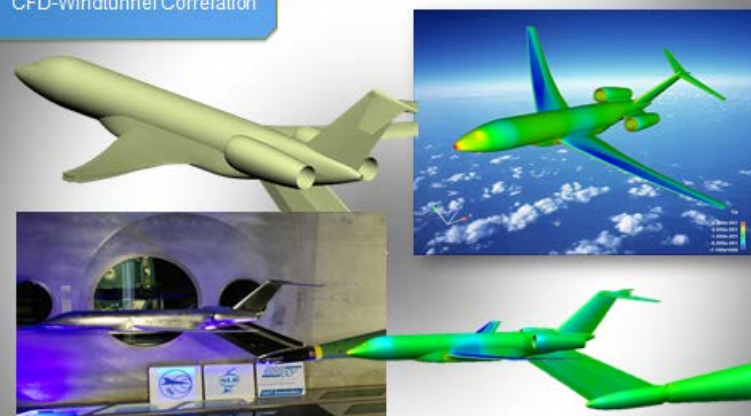


Initiative on Integrated Arrival / Departure / Surface Operations to increase throughput,  
reduce delays, reduce fuel burn, reduce emissions, reduce noise

## Technical Cooperation



### CFD-Windtunnel Correlation



中国航空研究院 CFD 开放式国际合作

## Vertical Lift

- On a low TRL level IFAR could contribute to the definition and outline of future rotorcraft by discussing rotorcraft as part of future air transport systems.
- IFAR could elaborate a global vision of future vertical lift systems
- in a subsequent breakdown process this vision could be transferred into international and national research activities and programs.
- Thus a globalized top-down approach could be realized, also integrating IFAR activities into national and international research.



## Future of Aviation by IFAR



## Future of Aviation – Why ?

- IFAR can offer views based on very different cultural and educational backgrounds and from a wide variety of different perspectives.
- Individual IFAR member organizations engage in regional or national strategic research agendas
- These various perspectives have not been commonly analyzed and discussed in a global context
- But already today the elements of the value chain of the air transport system are of global nature
- and thus it might prove beneficial to commonly look for predominantly (but not only) global solutions and areas of commonality to tackle the challenges of the future





## Future of Aviation – What ?



## Future of Aviation – What we know already



## Future of Aviation – Some examples of open issues





### Potential future role of IFAR?



### Future of Aviation by IFAR

