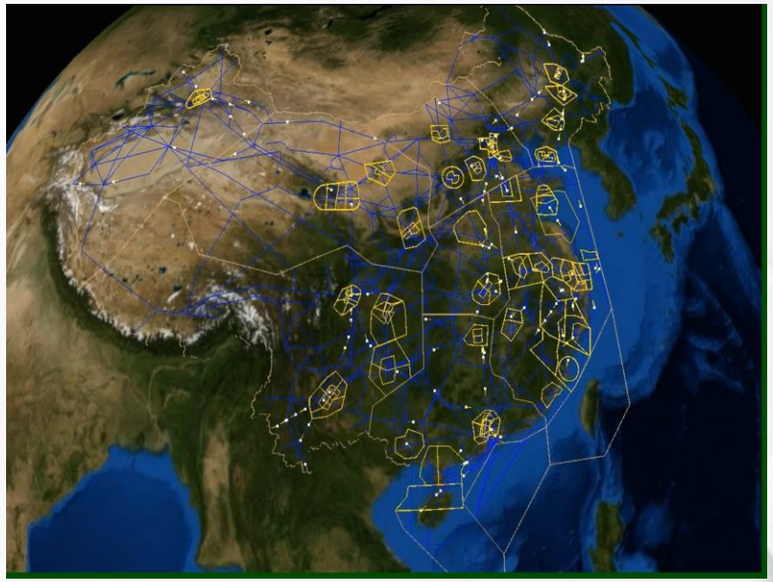
Flight Procedure Design Quality Assurance Webinar

Ground Validation and regarding software using in China

October 27th, 2020

Foreword— Ground Validation plays a crucial role in this process



- **In 2019, China achieved a passenger throughput of 660 million passenger trips, ranking the second in the world for 15 years consecutively;**
- **Every day, 246 airports and nearly 1,000 flight procedures to protect the safety of various flights;**

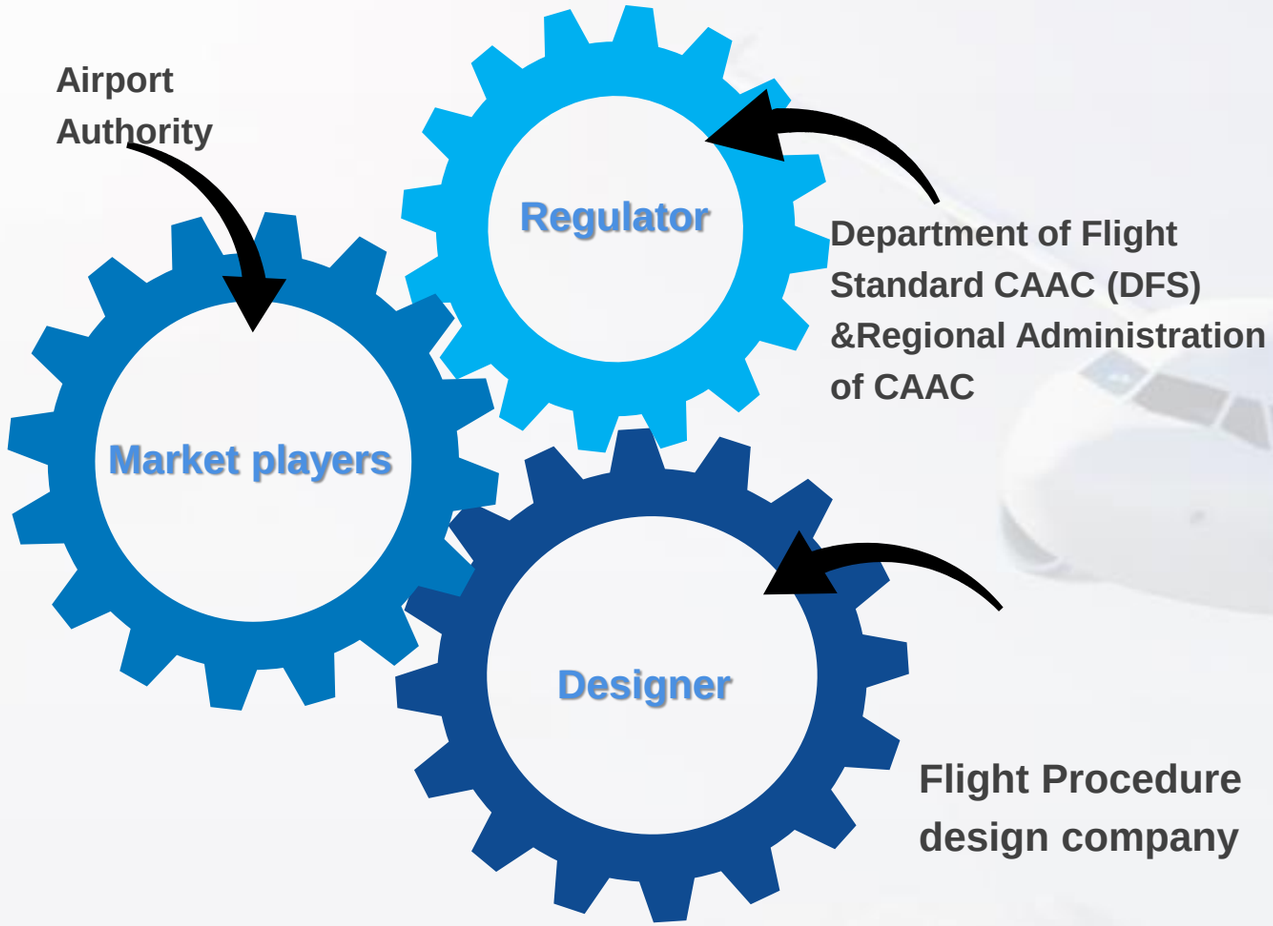
Each flight procedure was meticulously designed through the stringent supervision of the CAAC and the close coordination of various stakeholders, and Ground Validation plays a crucial role in this process.

CONTENTS

01

Current situation on ground validation of IFP in China

China's flight procedure management system



The role of the ATMB (ANSP)

- Airspace Management Center and it’s sub office in regional ATMB — Coordinator
- ATM operation organization— User
- AIP center— Publisher
- FPD company— the Designer

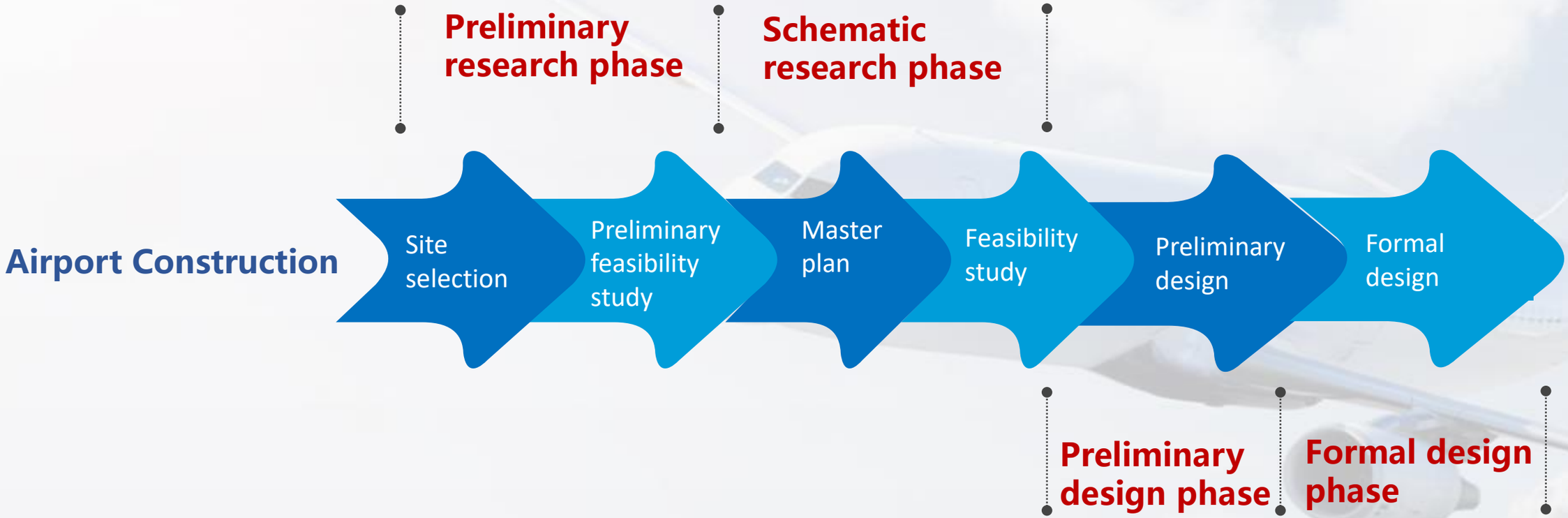
Flight Procedure Item Classification

FP Item

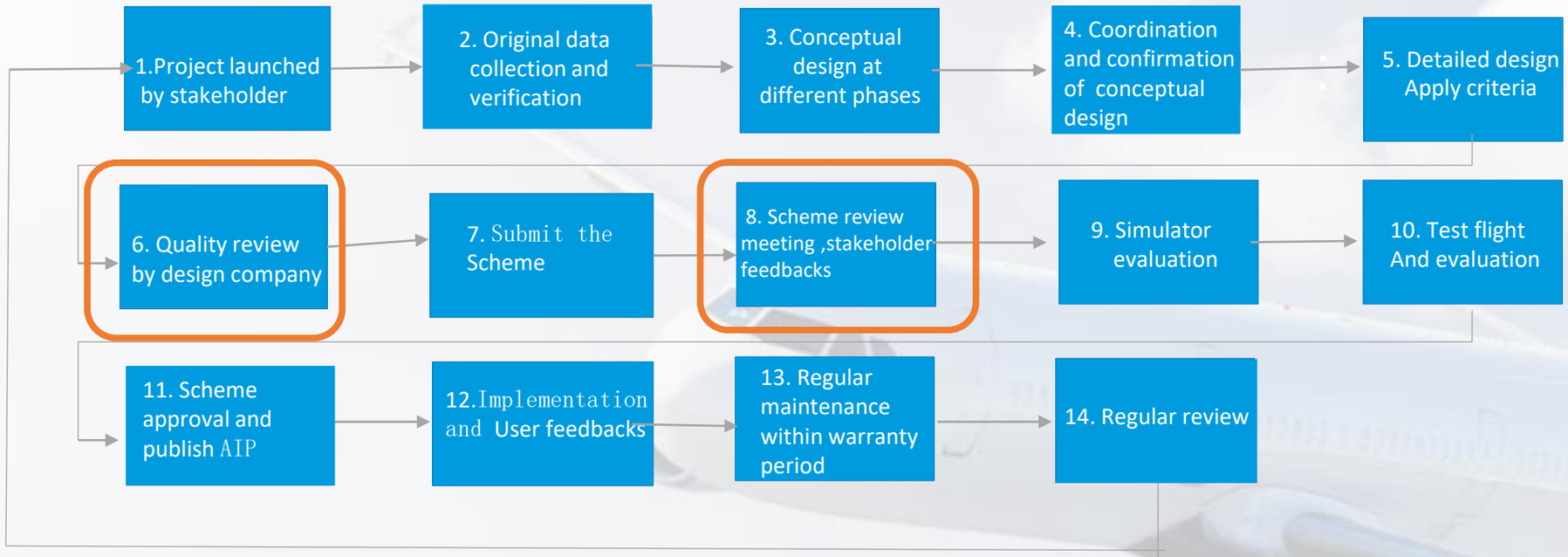
- **New flight procedure**
  - For a new airport
  - For reconstructed and expanded airport
- **Modified flight procedure**
  - Caused by adjustment of peripheral routes of terminal area
  - Caused by optimization of existing procedure
  - Caused by application of new technologies

Process Flow of Flight Procedure Design of New Airport

Flight procedure design of a new airport normally takes a long time



Complete Flight Procedure Design Process Flow



- **Preliminary and Schematic research and preliminary design phase (Steps 1 to 8)**
- **Formal design phase (step 1 to 13)**
- **Ground Validation (Step 6 to 8)**

Current Ground Validation work flow

Current GV work flow

Quality review by design company

- Additional designer from the same design team, or
- Reviewer from specialized quality assurance department(not mandatory)
- The flight procedure reviewer should sign on the first page of the report

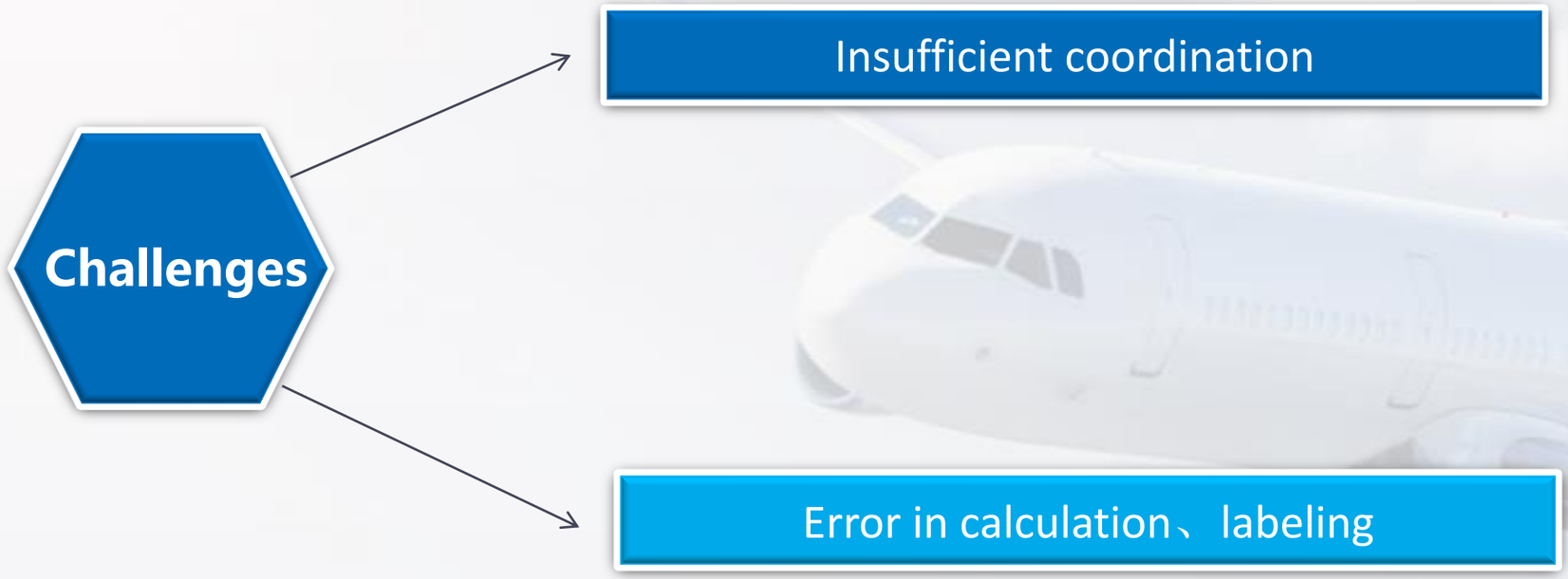
Scheme review meeting hold by regional CAAC

- Organized by the regional administration
- flight procedures will be reviewed by experts in airspace, air traffic control, airlines etc.
- If approved by the meeting, flight validation can proceed

02

Challenges in the process of ground validation of IFP

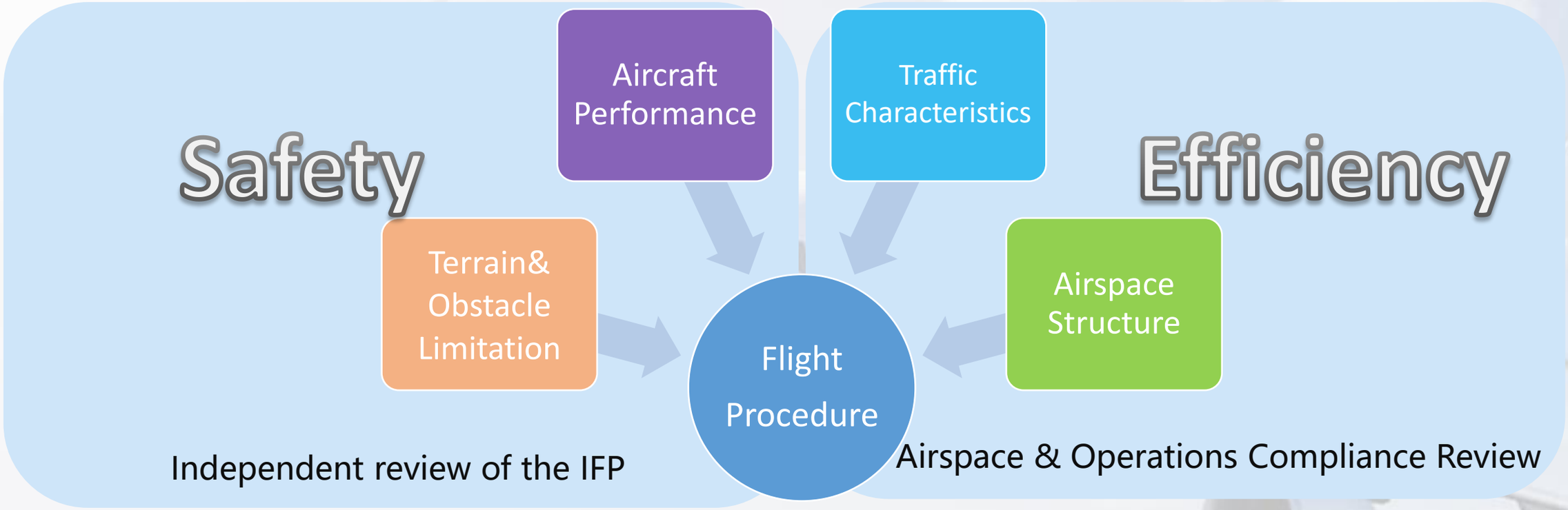
Challenges and root cause analysis



Challenges in the process of ground validation of IFP

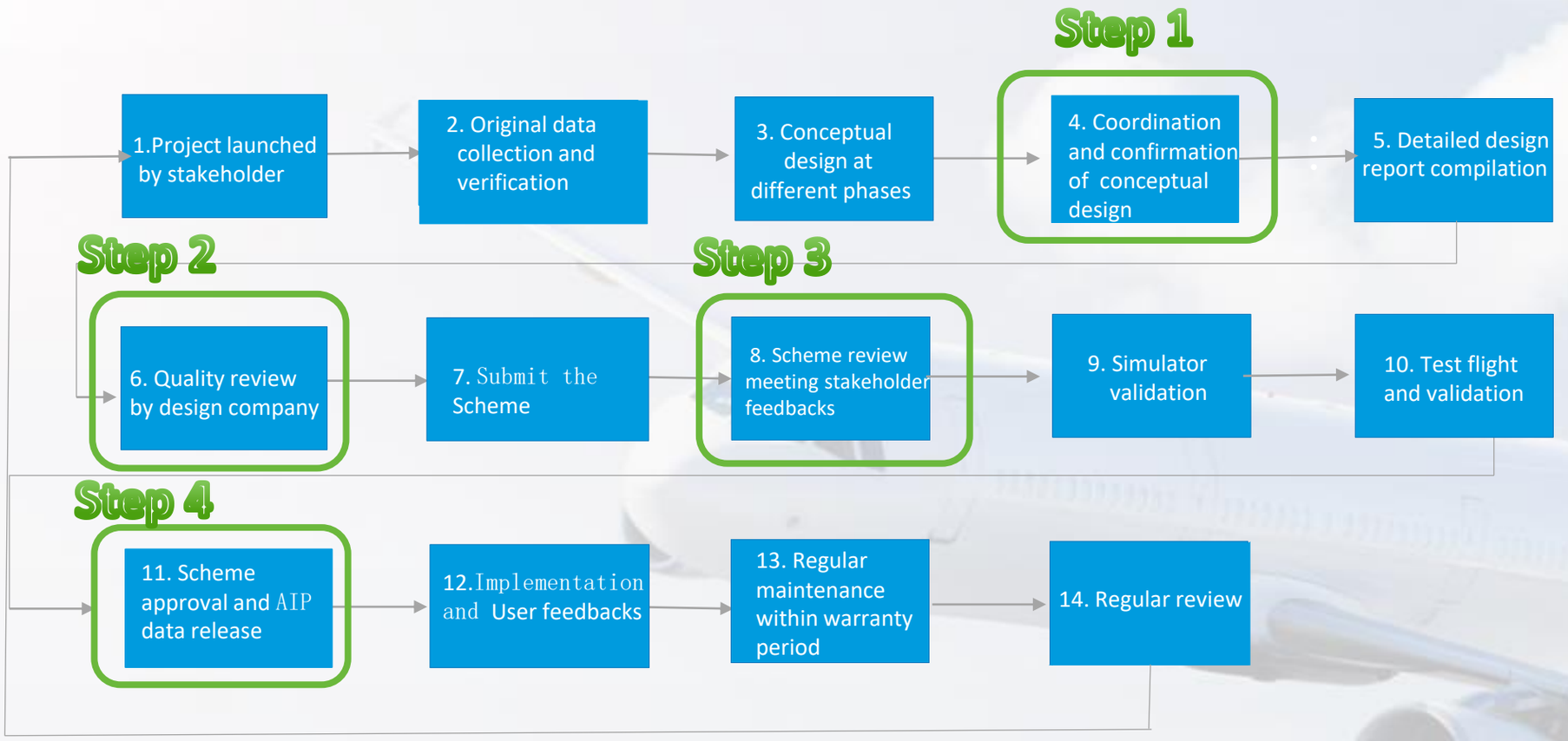
Solutions

Two elements we Evaluated as a good Procedure



Two critical elements of Ground Validation for ANSP

4-step solutions



- **Step 1**: Sufficient communication and coordination with ANSP during concept design
- **Step 2**: More stringent requirement for GV by FSD + software support from ANSP
- **Step 3**: ATMB expert profile control (qualification, local experience)
- **Step 4**: Additional check on airspace compliance before publishing

03

Introduction to ground validation software of IFP for ATMB system

Introduction

Position in the market

a desktop application assist the designer to review of FPD schemes

Users

Anyone who needs to check the quality of the procedure, incl. QA，airspace compliance reviewer

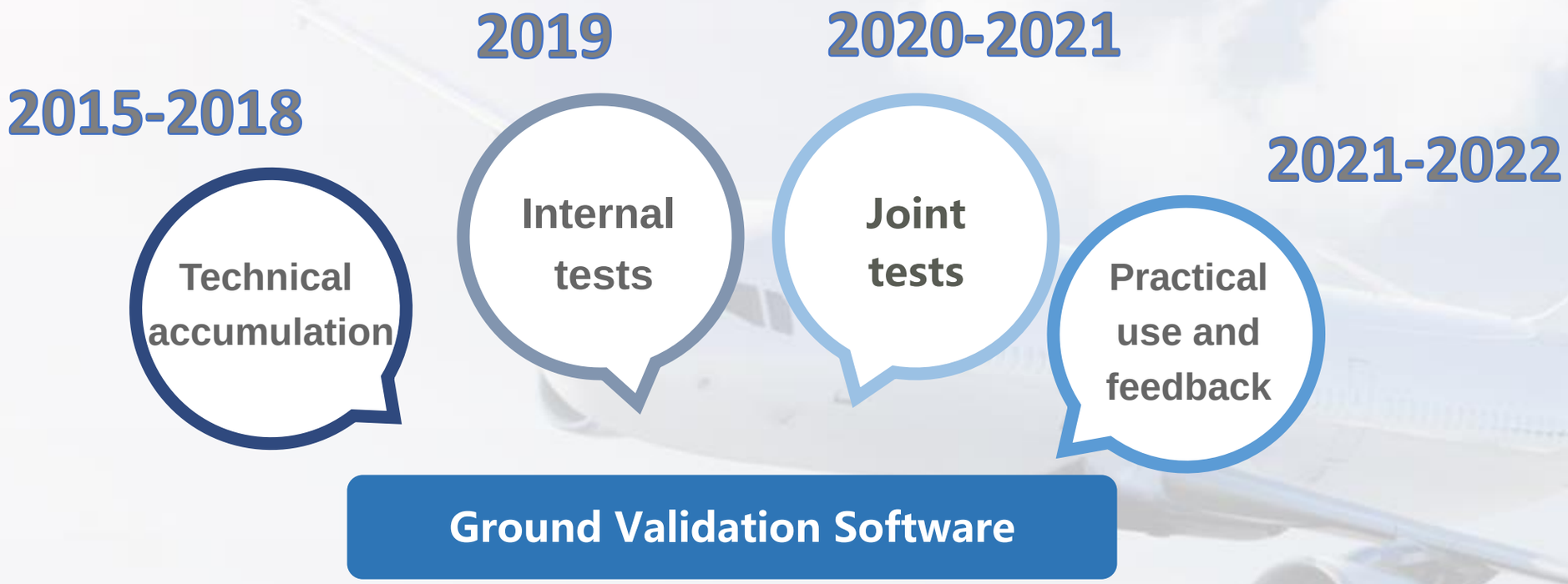
Purpose

Systematic review of the steps and calculations involved in the procedure design.

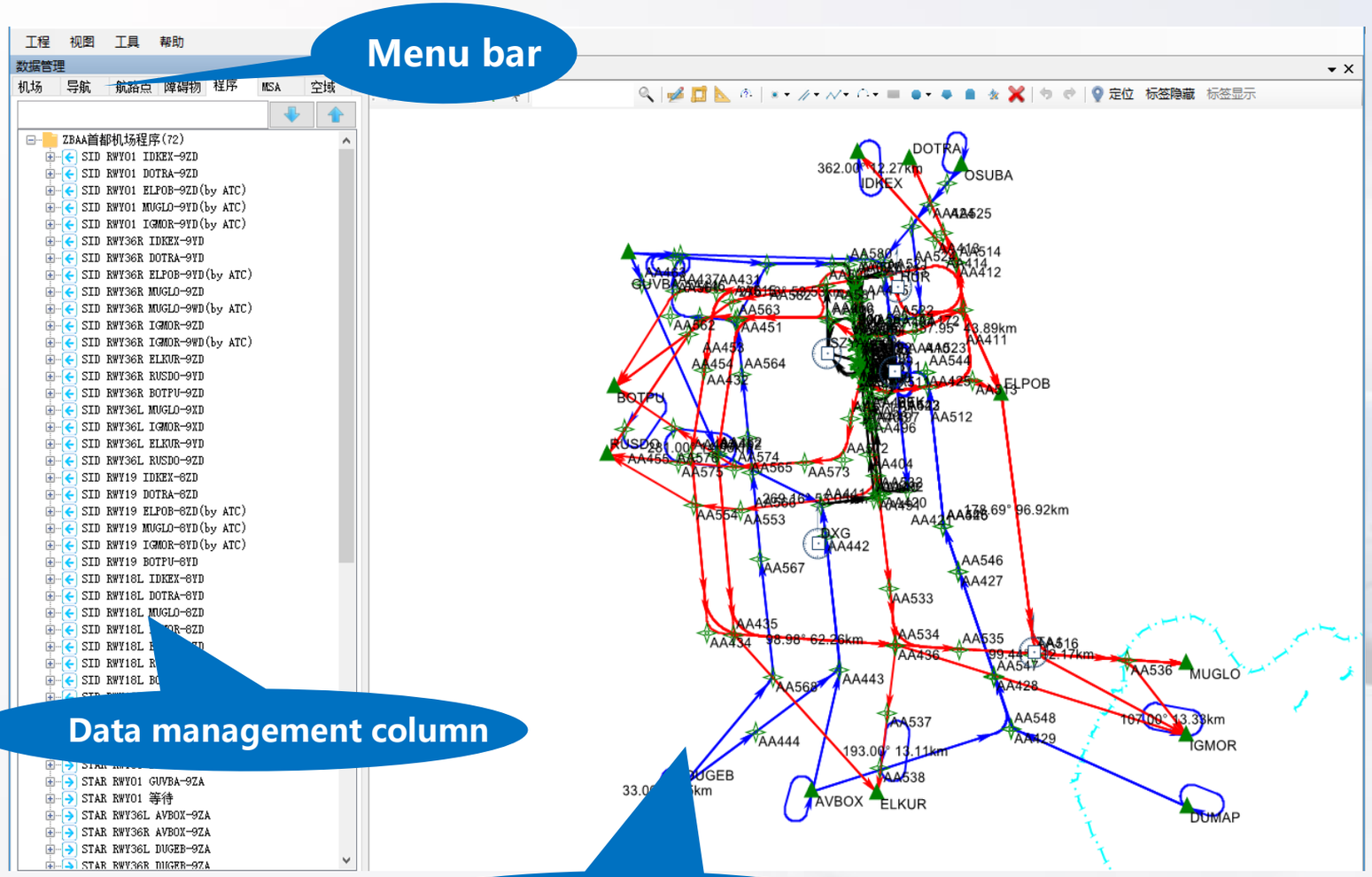
Used when

GV process during Preliminary design phase& Formal design phase

Timeline of Ground Validation software of ATMB System



Software interface and Functionalities



- Data Management
- Review IFP scheme
- Drawing and Labeling
- Airspace compliance Review

Advantages of the software

Ground Validation software

1. ◆User friendly based on open source GIS platform and open for customized development
2. ◆Fully data driven to produce one-click generation due to Aeronautical Information Exchange Model(AIXM) and ARINC424 data Based
3. ◆Doc8168 rules based and can send notifications
4. ◆Automatic Obstacle Assessment
5. ◆Charting automation integrated

Regulation reference of the Software

Built-in Database for Doc8168 rules and rule checking

CAAC Advisory Circulars

ICAO relevant standard

Error message window

Error Message

Error1 | Warning0 | Information0

	Serial number	Type	Illustrate	Reference name	Reference section
▶	0	Error	A straight departure may permit a turn of 15° or less	Doc8168 (Sixth edition)	Part I, Section 3, Chapter2, 2.2.3

Fully data driven due to ARINC424 data Based

ARINC

NAVIGA

ARII

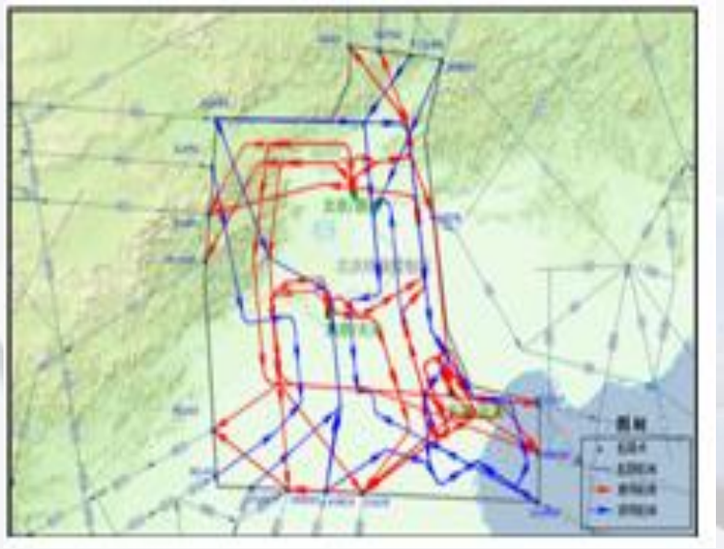
AN ARINC DOCUMENT

Prepared by AEEC
Published by
AERONAUTICAL RADIO, INC.
2551 RIVA ROAD, ANNAPOLIS, MARYLAND 21401

数据库编码 北京/首都

航径描述	定位点标识	是否飞越点	磁航向(°)	转弯指示	高度(m)	速度限制(kt)	VPA/TCH	导航性能
TF	AA411				2100	MAX250		RNAV1
TF	AA412				3200 3000			RNAV1
TF	AA413				3600			RNAV1
TF	IDKEX				4200			RNAV1
RWY36R 离场 DOTRA-9YD								
CA			359		900			RNAV1
DF	AA410			R	900			RNAV1
TF	AA411				2100	MAX250		RNAV1
TF	AA412				3200 3000			RNAV1
TF	AA414				3600			RNAV1
TF	DOTRA				4200			RNAV1
RWY36R 离场 ELPOB-9YD (by ATC)								
CA			359		900			RNAV1
DF	AA410			R	900			RNAV1
TF	AA411				2100	MAX250		RNAV1
TF	ELPOB				2400			RNAV1
RWY36R 离场 MUGLO-9YD								
CF	AA430		359		1500			RNAV1
TF	AA431				4200			RNAV1
TF	AA432				5400			RNAV1
TF	AA433				6000			RNAV1
TF	AA434							RNAV1
TF	AA435							RNAV1
TF	AA436							RNAV1
TF	MUGLO				6000			RNAV1
RWY36R 离场 MUGLO-9WD (by ATC)								
CA			359		900			RNAV1
DF	AA410			R	900			RNAV1
TF	AA411				2100	MAX250		RNAV1
TF	ELPOB				2400			RNAV1
TF	AA516				6000			RNAV1
TF	MUGLO				6000			RNAV1
RWY36R 离场 GMOR-9ZD								
CF	AA430		359		1500			RNAV1
TF	AA431				4200			RNAV1
TF	AA432				5400			RNAV1

IFP data package (Navigation database coding)

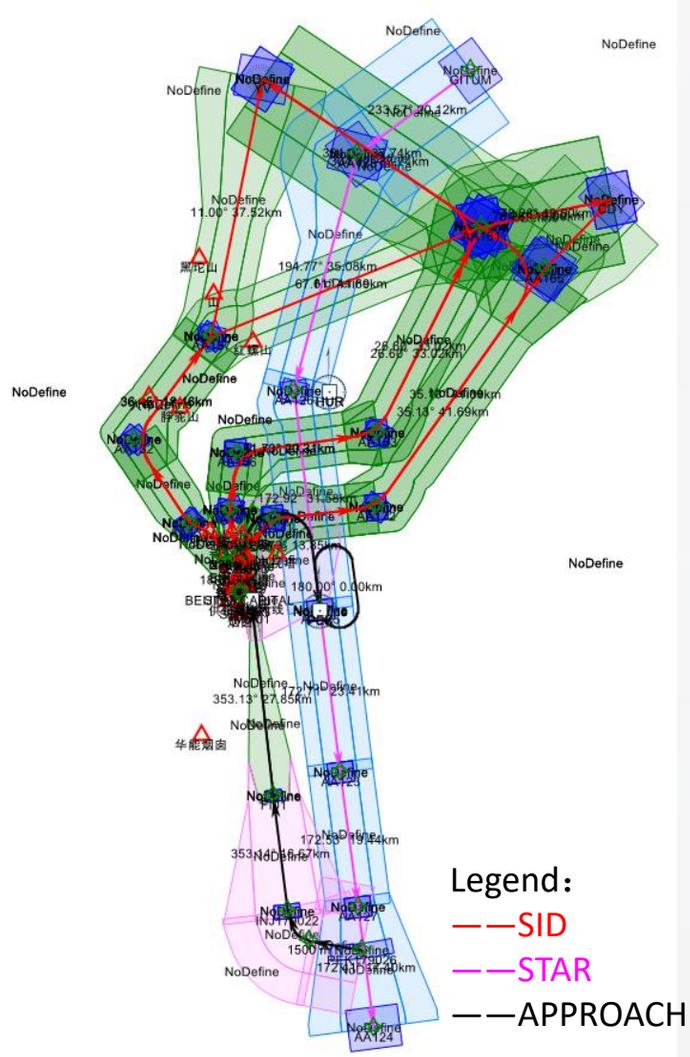


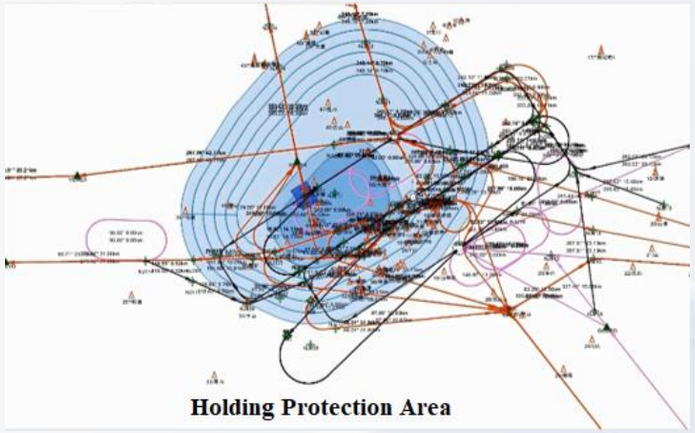
Generate the Nominal Track

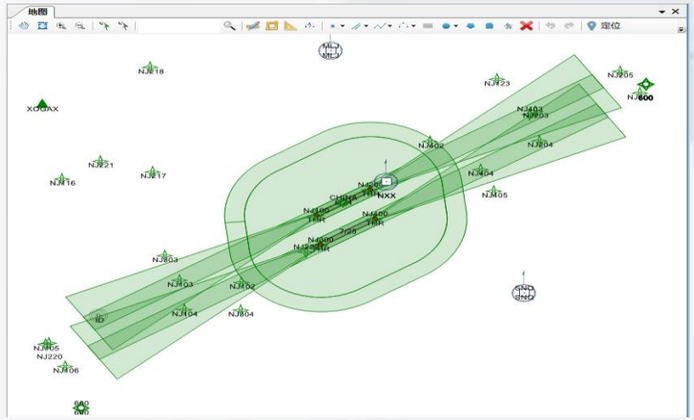
Export to the flight simulator and Fast time simulator

Automatic Drawing of Protection Area

2D Drawing interface

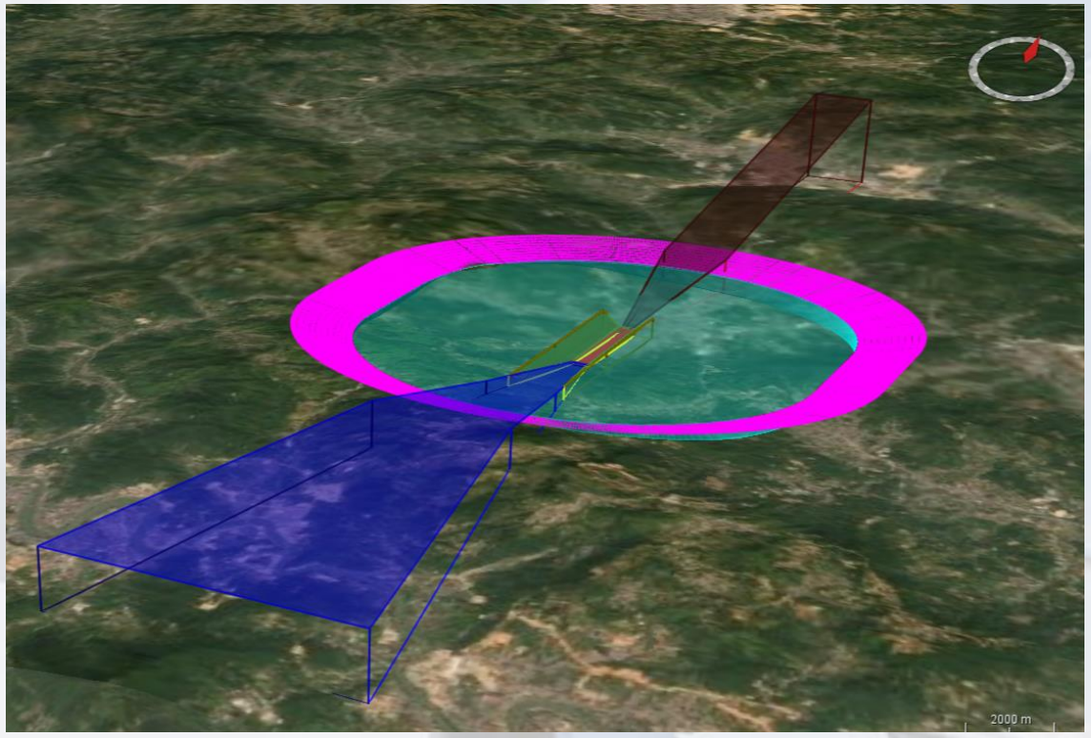






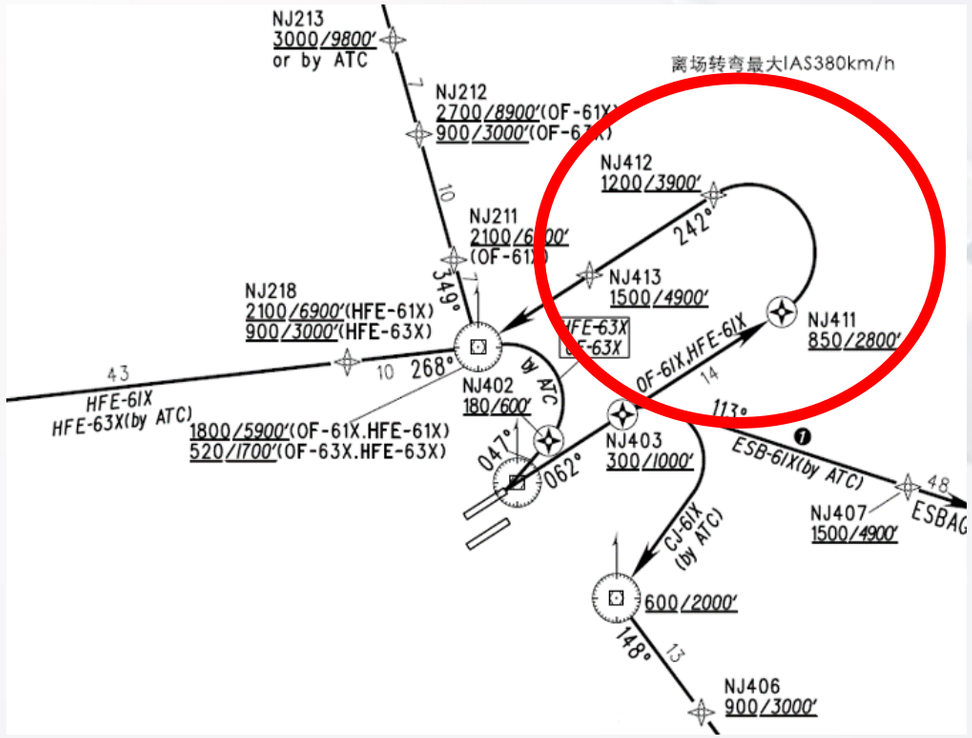
Annex 14 surface 2D sketch map

3D Drawing interface

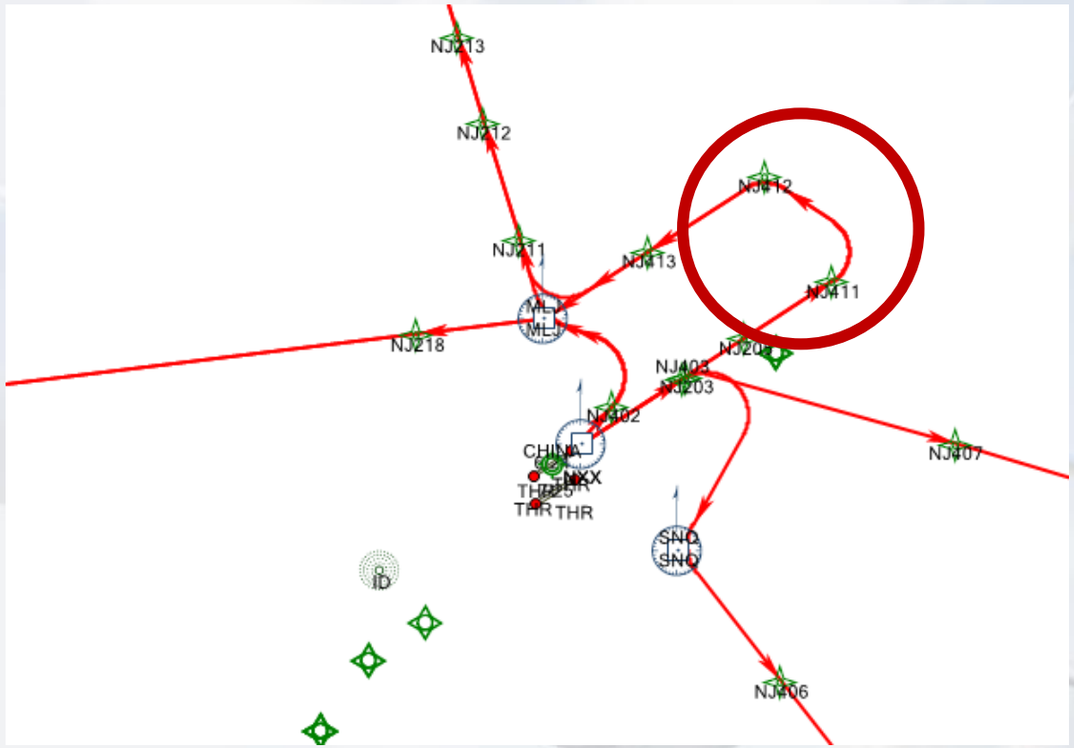


Annex 14 surface 3D sketch map

More accurate track demonstration

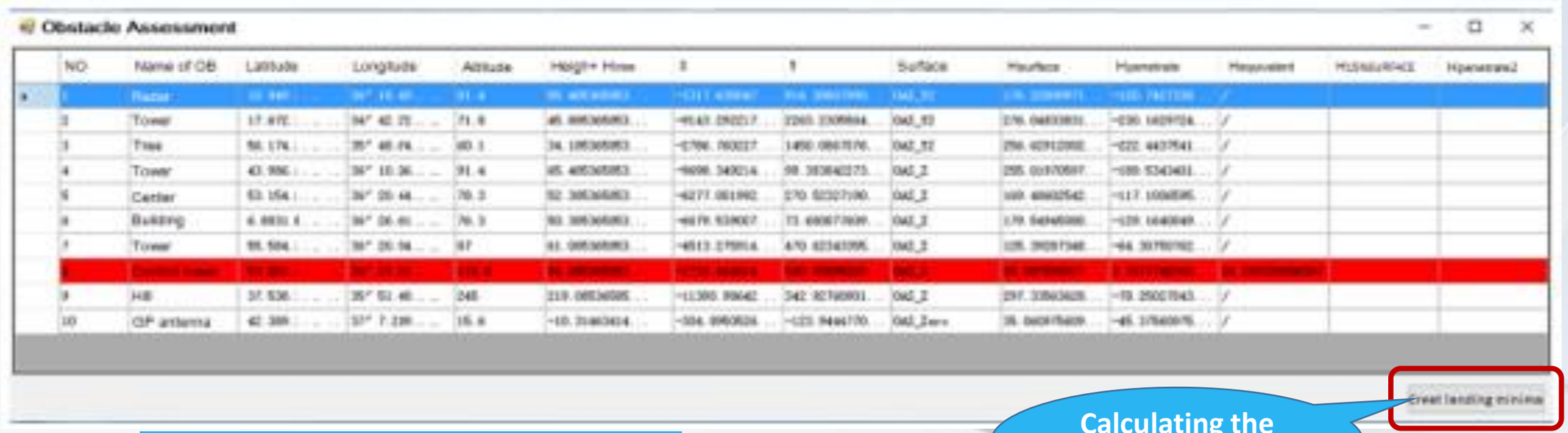


VS

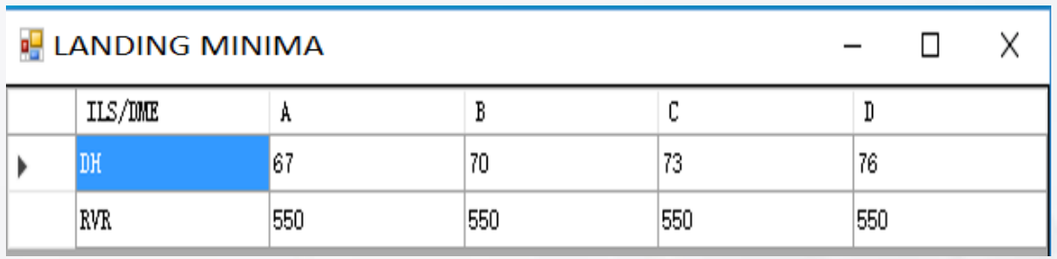


Automatic Obstacle Assessment

Obstacle assessment table



minima box



Data-driven Charting and Report

Preliminary/Formal(or Modified, Optimized)design report of flight procedure for XX civil airports

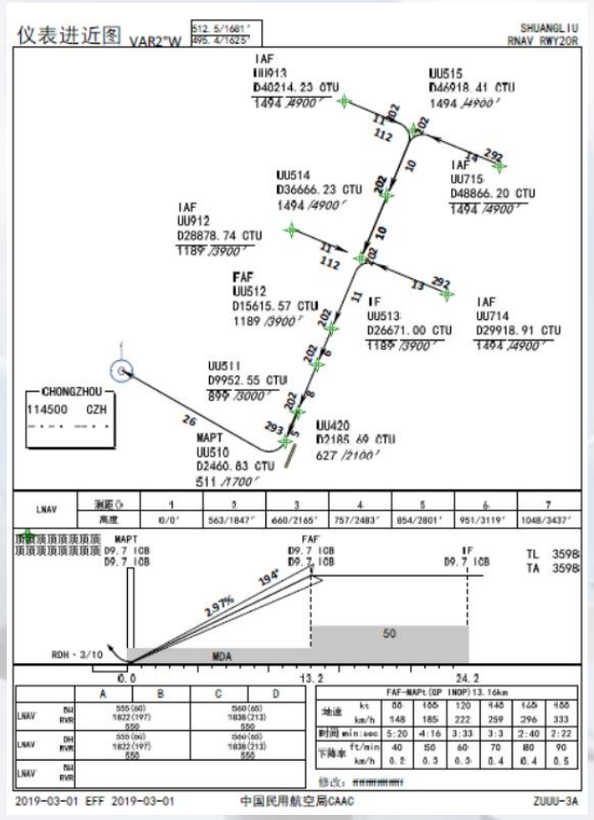
Design report of flight procedure for XX civil airports（Preliminary/Formal）

Catalogue

【Name of Design Unit】

【Design completion Date】M -Year

Report template issued by CAAC



Data-driven charting

Introduction to ground validation software of IFP for ATMB system

The Joint test

Objectives of the Joint test of the software

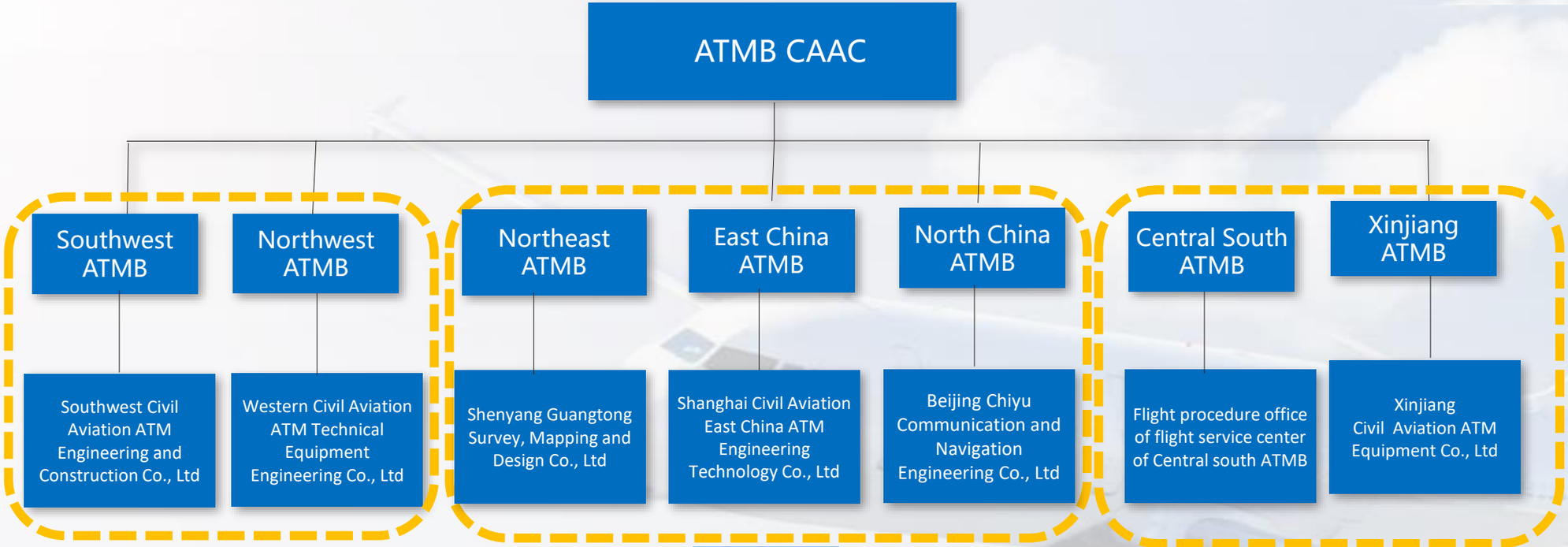
Facilitate the GV work?

Meet the Requirements of ICAO GV?

In line with the actual demand of FPD company ?

Objectives of Joint Test for Ground Validation Software

Joint test Flight Procedure Design Institute of ATM System



2019

Yi Bin airport—Formal Design Phase

Lanzhou Airport—Triple Runways

2020

Rui Jin airport— Obstacles& terrain

Sui Fenhe airport—Closer to the border

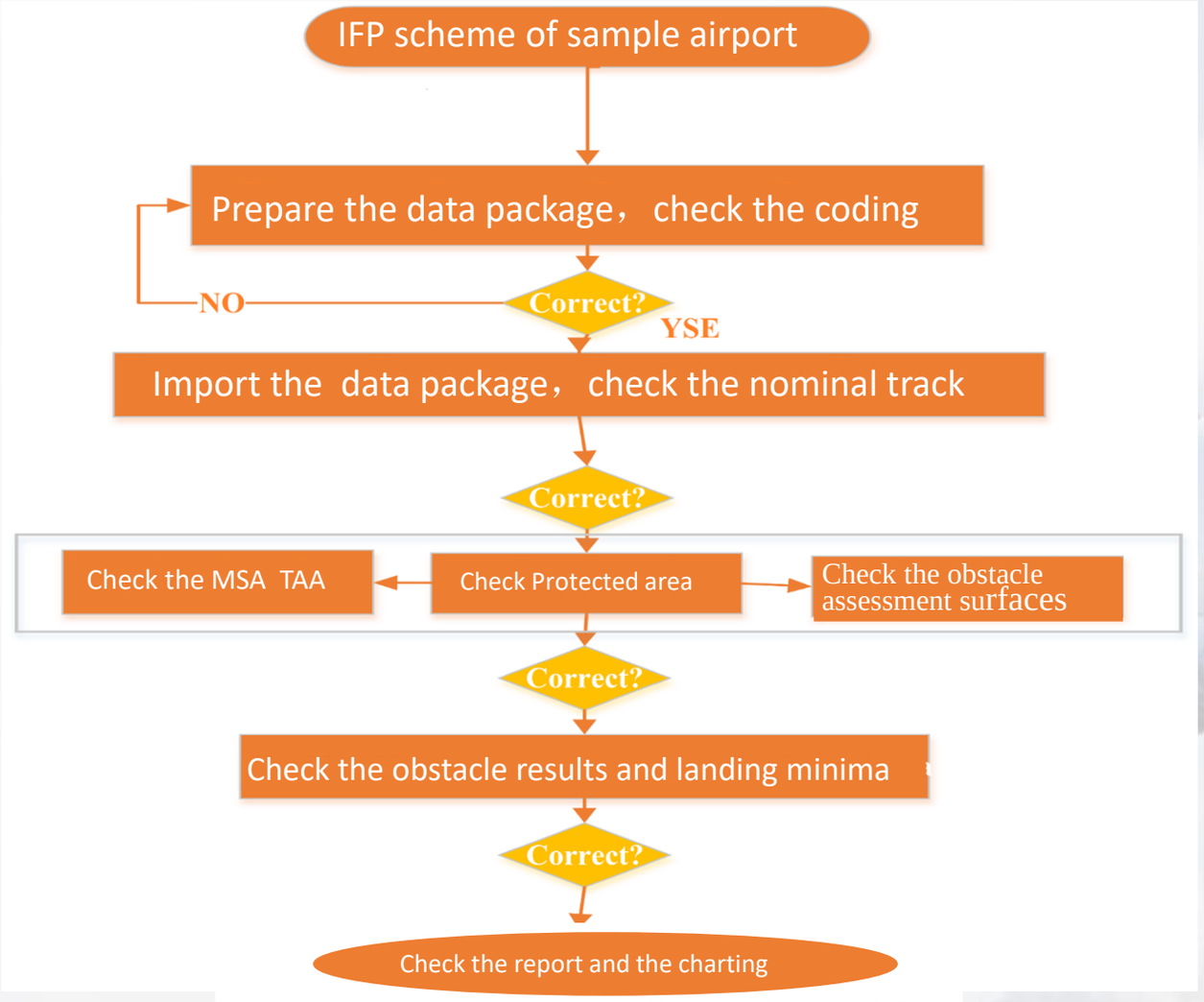
Beijing Capital airport—RNP AR procedure

2021

TBD

TBD

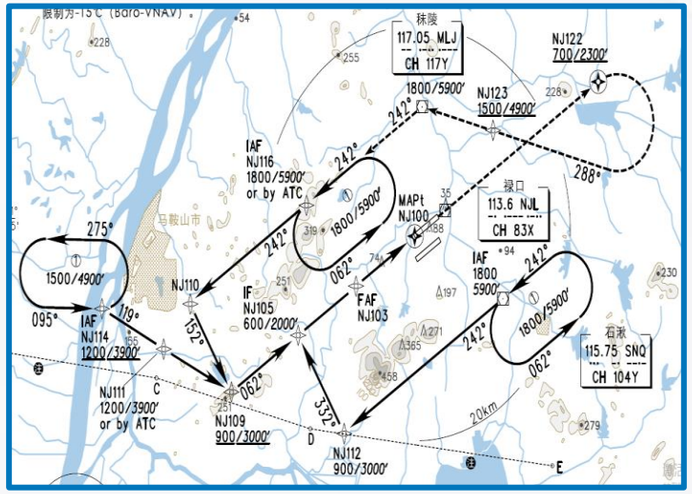
Process of using the software review a scheme



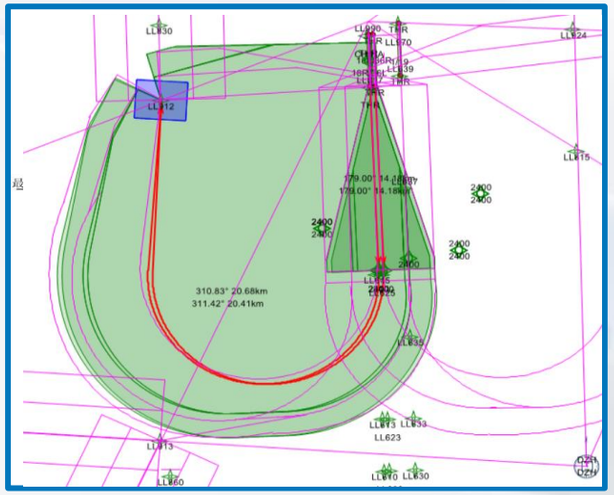
Process of using the software review a scheme

No.	The check list of a FPD scheme	No.	The check list of a FPD scheme
1	Minimum sector altitudes (MSA)	9	Obstacle assessment surfaces (OAS)
2	PBN Departure procedures	10	APV(*Approach procedure with vertical guidance*) OAS
3	PBN Arrival procedures	11	Parallel approach obstacle assessment surfaces (PAOAS)
4	APV/Barometric vertical navigation (BARO-VNAV)	12	Visual maneuvering (circling) area
5	PBN Non-precision approach procedures (LNAV)	13	Visual segment surface (VSS)
6	PBN to ILS transition approach procedures	14	Take-off path area
7	PBN Holding procedures	15	Basic ILS surfaces
8	Terminal Arrival Altitudes (TAAs)	16	Obstacle limitation surfaces(Annex 14 surface)

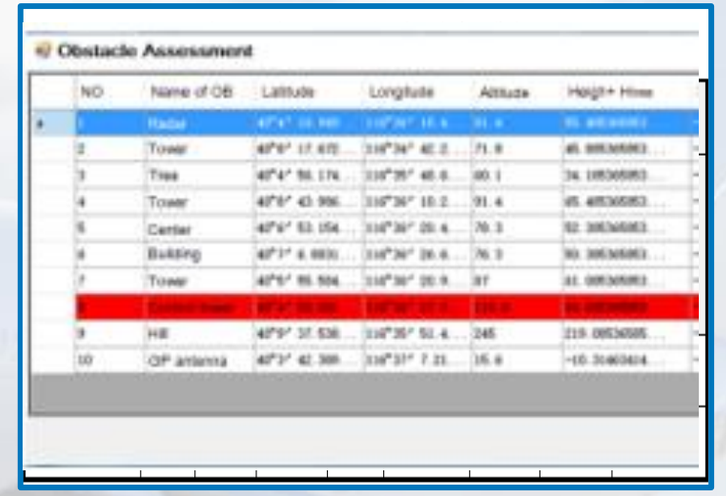
Three critical parts of the review of the FPD Scheme



The nominal track of FP



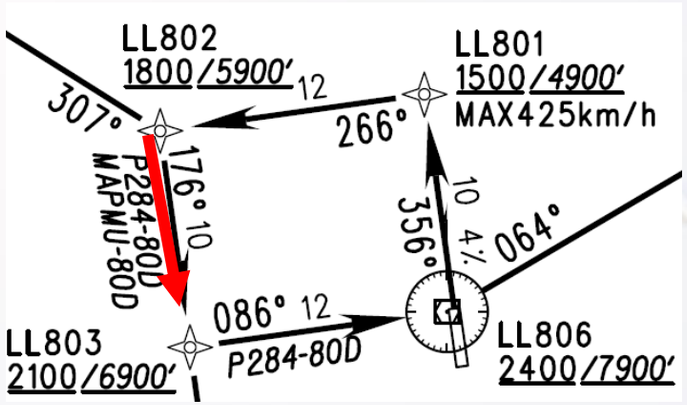
The Protection Area of FP



Results of Obstacle Assessment

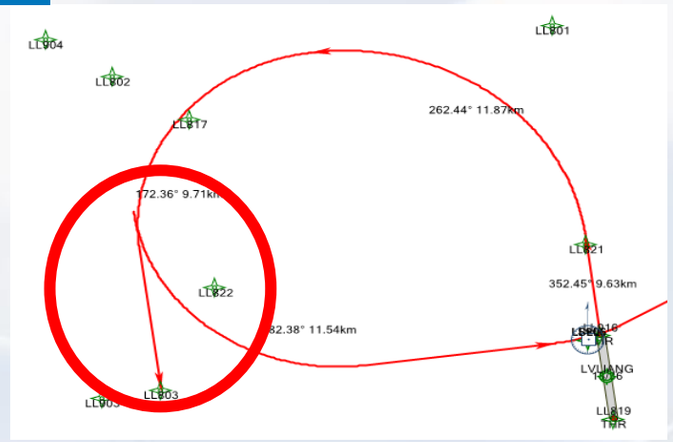
Mistakes found assisted by the software

Insufficient Stabilization Distance

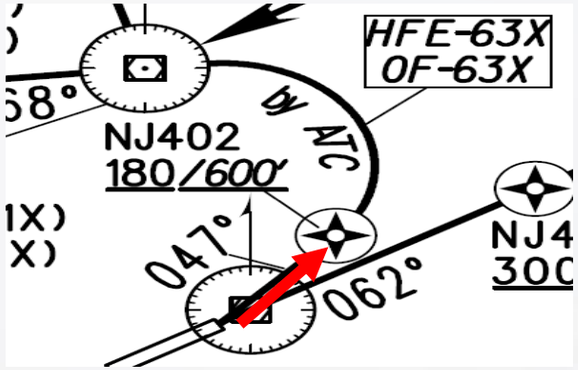


- Between two waypoints

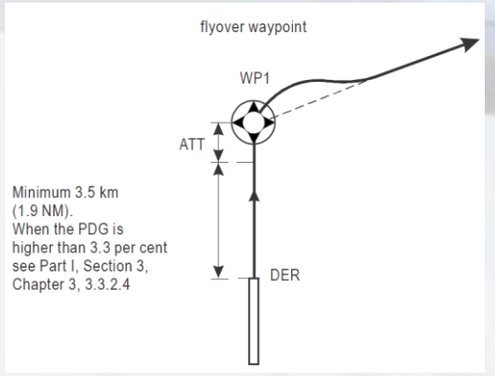
VS

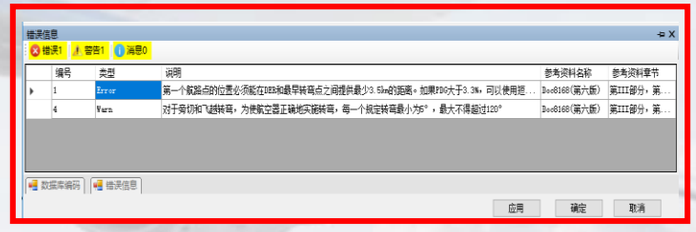


- The two segments do not join coherently



- DER—the first waypoint

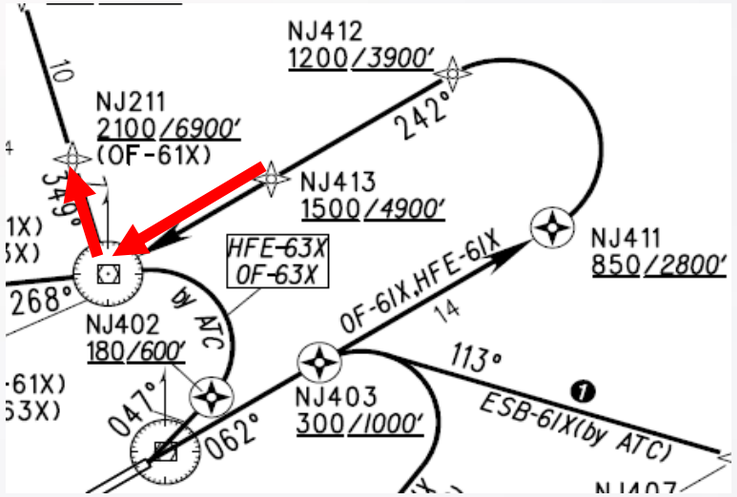




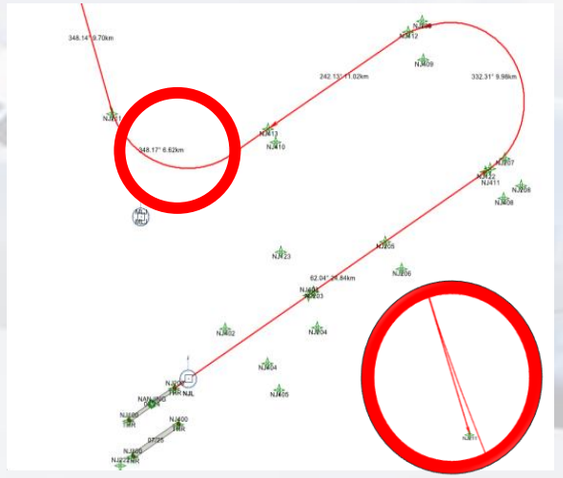
- Error message prompt window

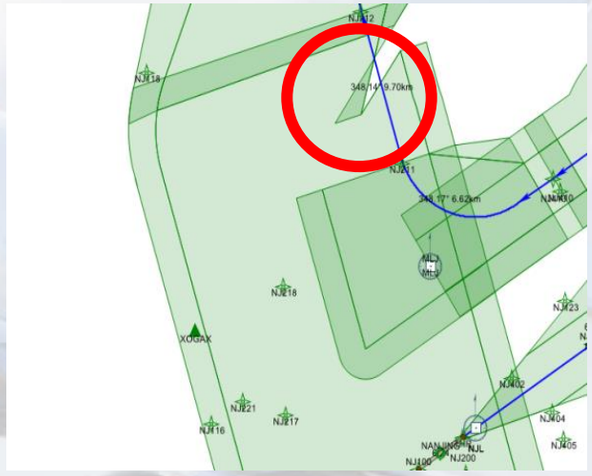
Mistakes found assisted by the software

- Large turn Angle



VS

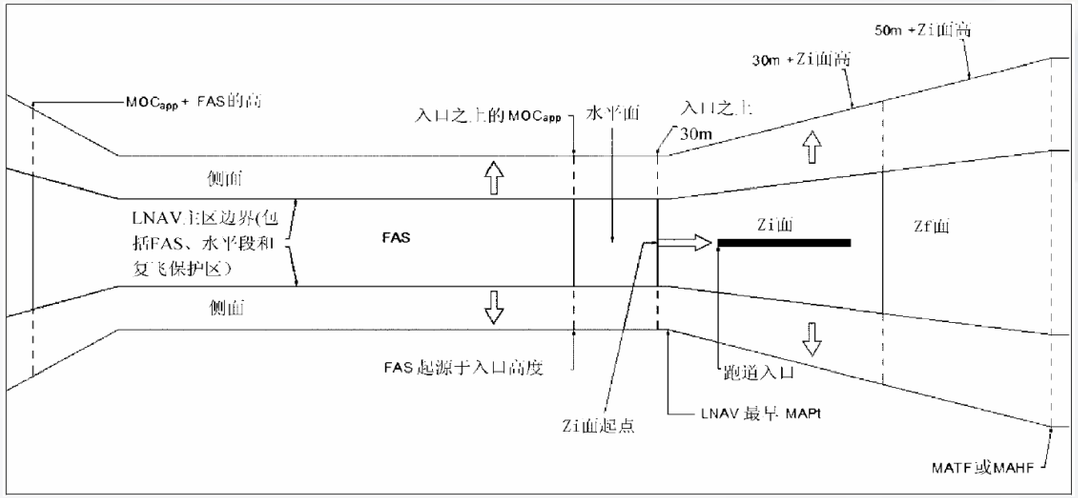




Mistakes found assisted by the software

- **Not updated with the amendment of Doc.8168**

		A	B	C	D
LNAV VNAV	DA(H) VIS	190(177) *630′(590′)* 2600		190(177) *630′(590′)* 2800	190(177) *630′(590′)* 3000

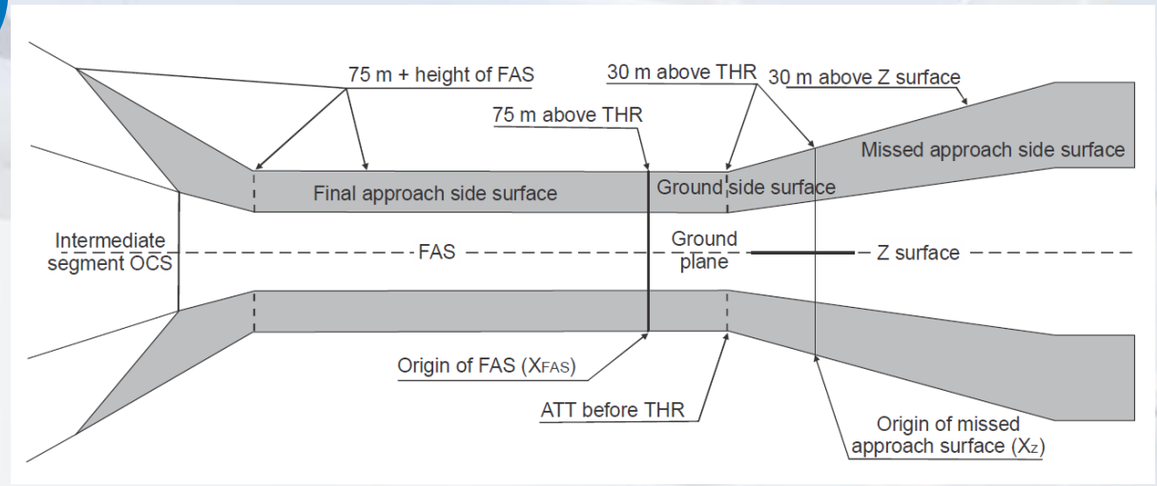


- **The previous version**

VS

着陆最低标准

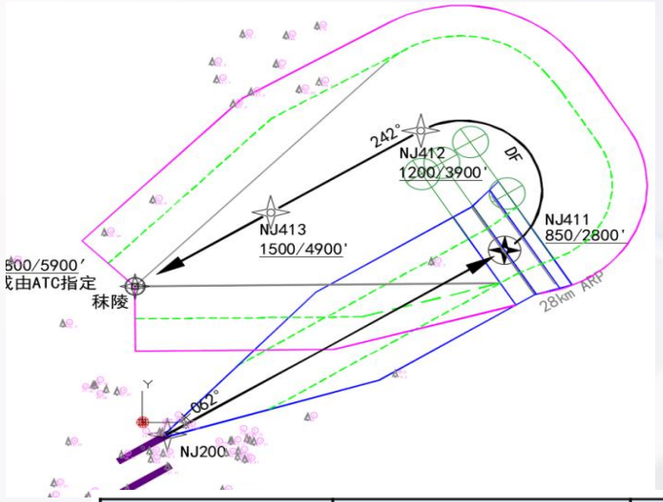
	LNVA VNAV	A	B	C	D
▶	DA(DH)	118(105)	121(108)	124(111)	127(114)
	VIS	1200	1200	1300	1300



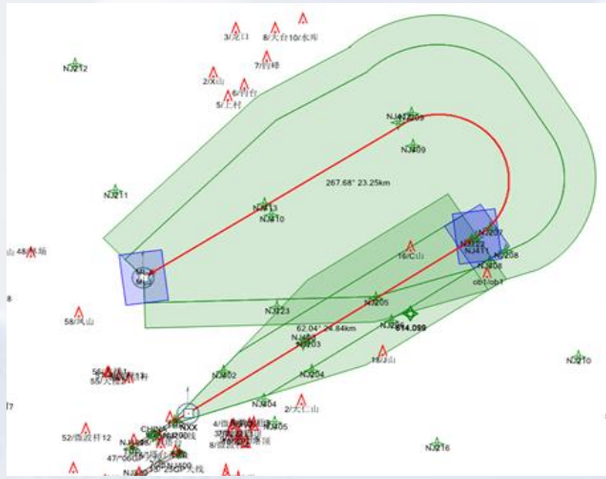
- **The latest version**

Accuracy of software

- Comparison of protection area



VS

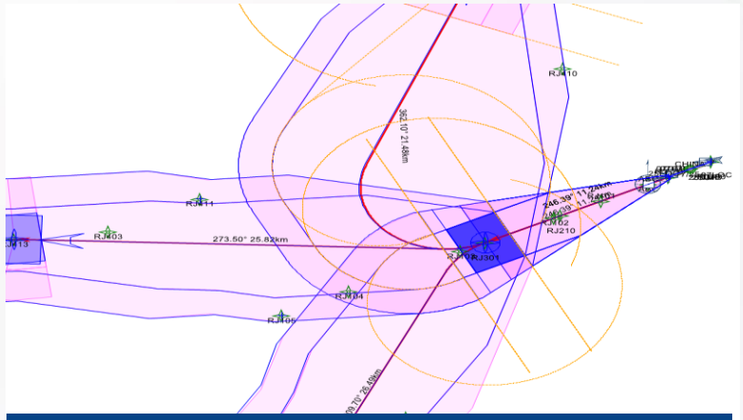


From	Turn radius （m）	C tolerance （m）	Latest point （m）	Earliest point （m）
FPD Scheme	5500	800	27101.6	13910.6
Software	5508.45	815.54	27136.27	13849.78
Difference	-8.45	-15.54	-34.67	-60.82

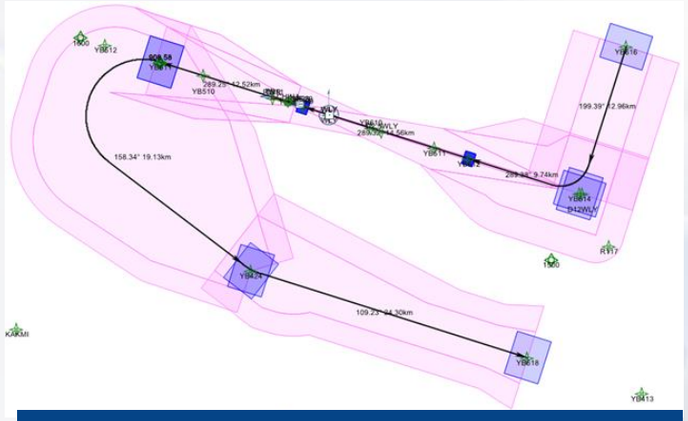
From	Obstacle	Dr/dr*（km）	d0（km）	Procedure altitude （m）	Required PDG
FPD Scheme	HILL	7.5	4.4	410	3.5%
Software	HILL	7.450913	4.4330125	410.1695	3.5%
Difference		0.049087	-0.0330125	-0.1695	0

Result： Distance difference is less than 100m, height difference is less than 1m

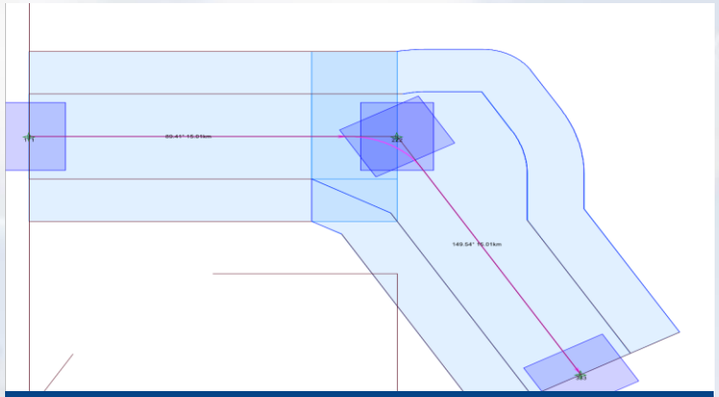
The improvement of the software during the joint test



The CAD design drawing can be imported for direct comparison；



Add PBN to ILS transition approach procedures



Optimize the wind spiral precision in the secondary area of the protection area

Positive test results

01 The horizontal and vertical accuracy of the software meet the requirements of the Doc.9906 specification.

02 Systematically review the application of the criteria and calculations involved in the FP

03 Easy to operate and intuitive, Good user feedback

The software basically meets the requirements of Ground Validation and can be used as a powerful supplement tool for the current GV process in ATMB system


Thank you !