
ICAO
INNOVATION
EUR/NAT WORKSHOP
Paris Office
#FUTUREAVIATION

France Aviation Civile Services

Innovation to boost Success

SafeNcy

AWARD
Scaling autonomous logistics

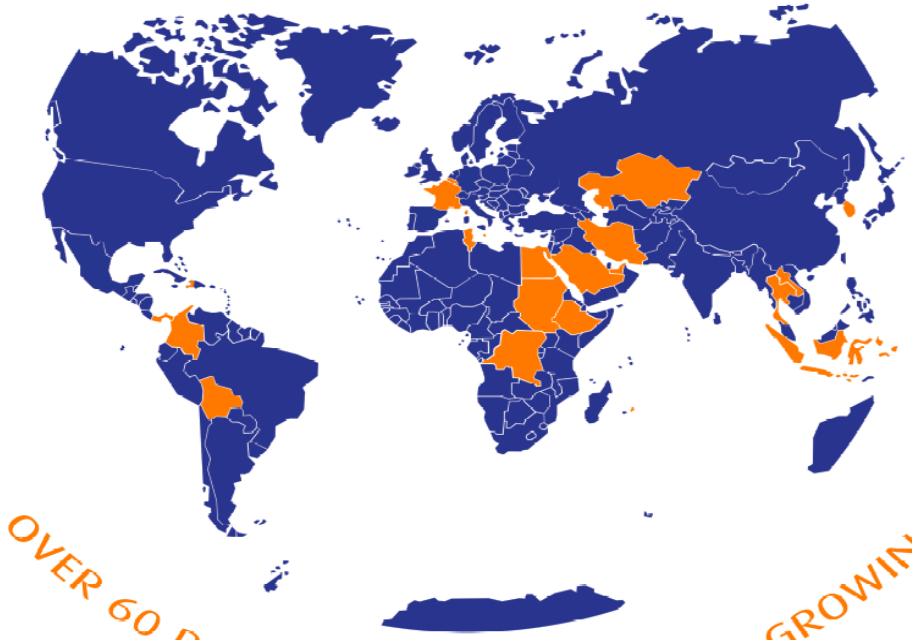
ZIZI Farid, Director, +33 616 522 403, zizi.farid@fracs.aero

France Aviation Civile Services

Expertise and consulting

Since 2013

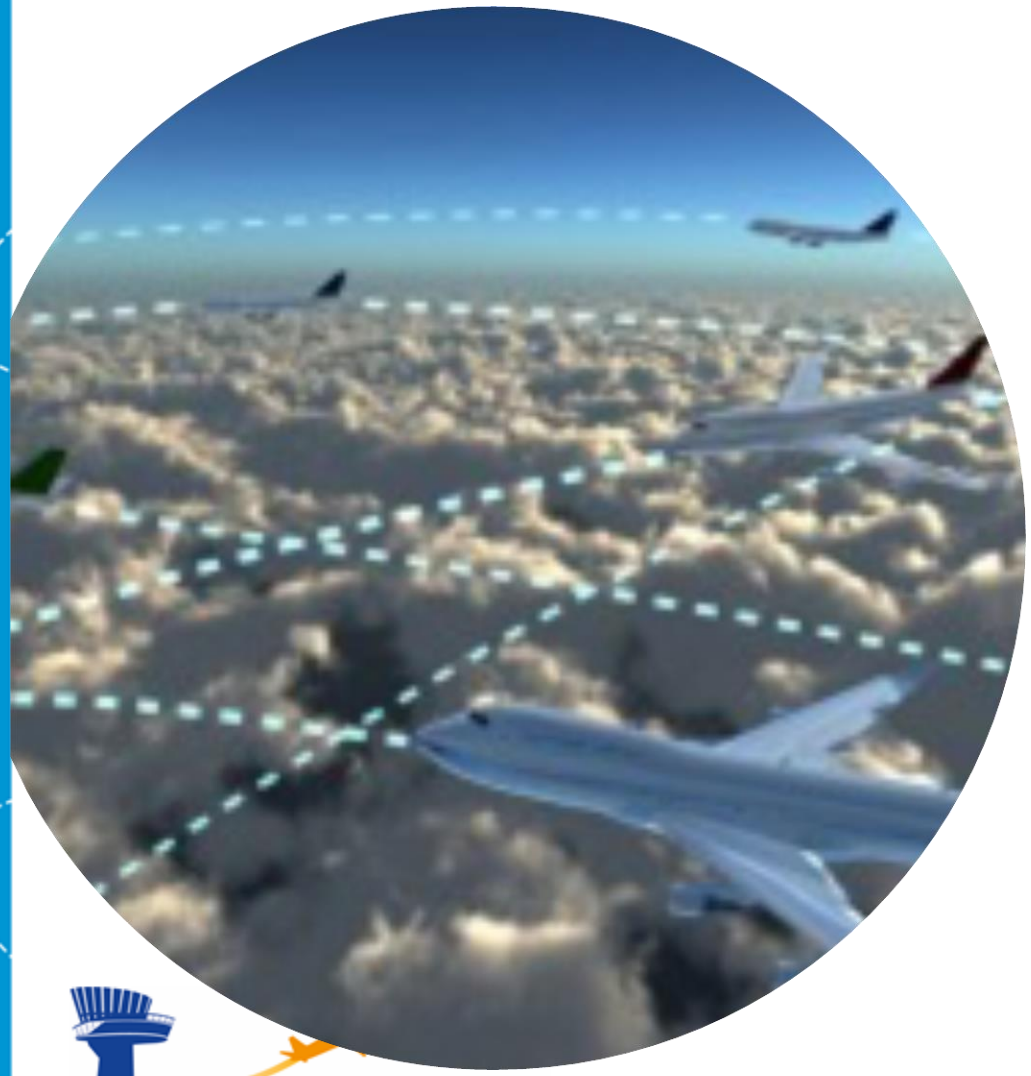
Founded by dgac ENAC



FRANCE AVIATION CIVILE SERVICES
Expertise and Consultancy Office of the French Civil Aviation

- Regulation and Supervision
- Optimization of operations
- Air transport statistics
- Operational Training
- Techniques and Innovation

INNOVATION: WHAT IS IT?



FRANCE
AVIATION CIVILE
SERVICES
Expertise and Consultancy Office of the French Civil Aviation

Innovation is the constant search for improvements to the existing, as opposed to invention, which aims to create something new.

Innovation is the practical implementation of ideas that result in the introduction of new goods or services or improvement in offering goods or services.

A Few examples of Innovative projects by FRACS

- SafeNcy
- PAPI Calibration Using Drones
- AWARD
- DIADEME
- ATD Analytics
- METEOR

SafeNcy

The Safe Emergency Trajectory Generator

ICAO INNOVATION

SafeNcy

Assisting the flight crew in emergency situation

This project has received funding from the Clean Sky 2 Joint Undertaking (JU) under grant agreement No 864771. The JU receives support from the European Union's Horizon 2020 research and innovation program and the Clean Sky 2 JU members other than the Union

SAFENCY: INTRODUCTION

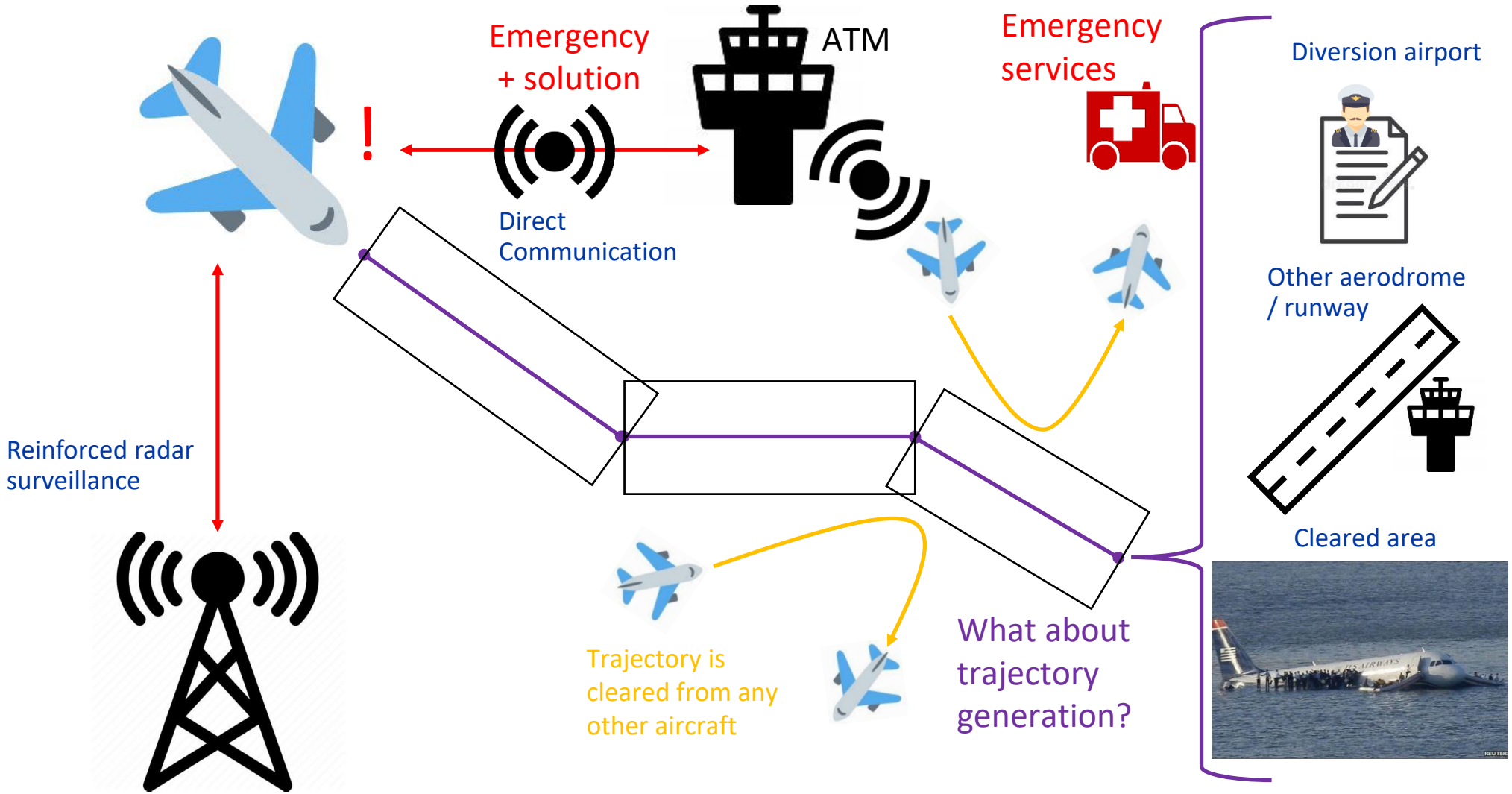
Operational Context – Flying the aircraft during the emergency

- What is the emergency? Can I cling to a known Procedure?
- Am I assisted by Avionics systems? Or shall I find the solution all by myself?

- Where to land the aircraft?
- How can I reach my Landing Site?

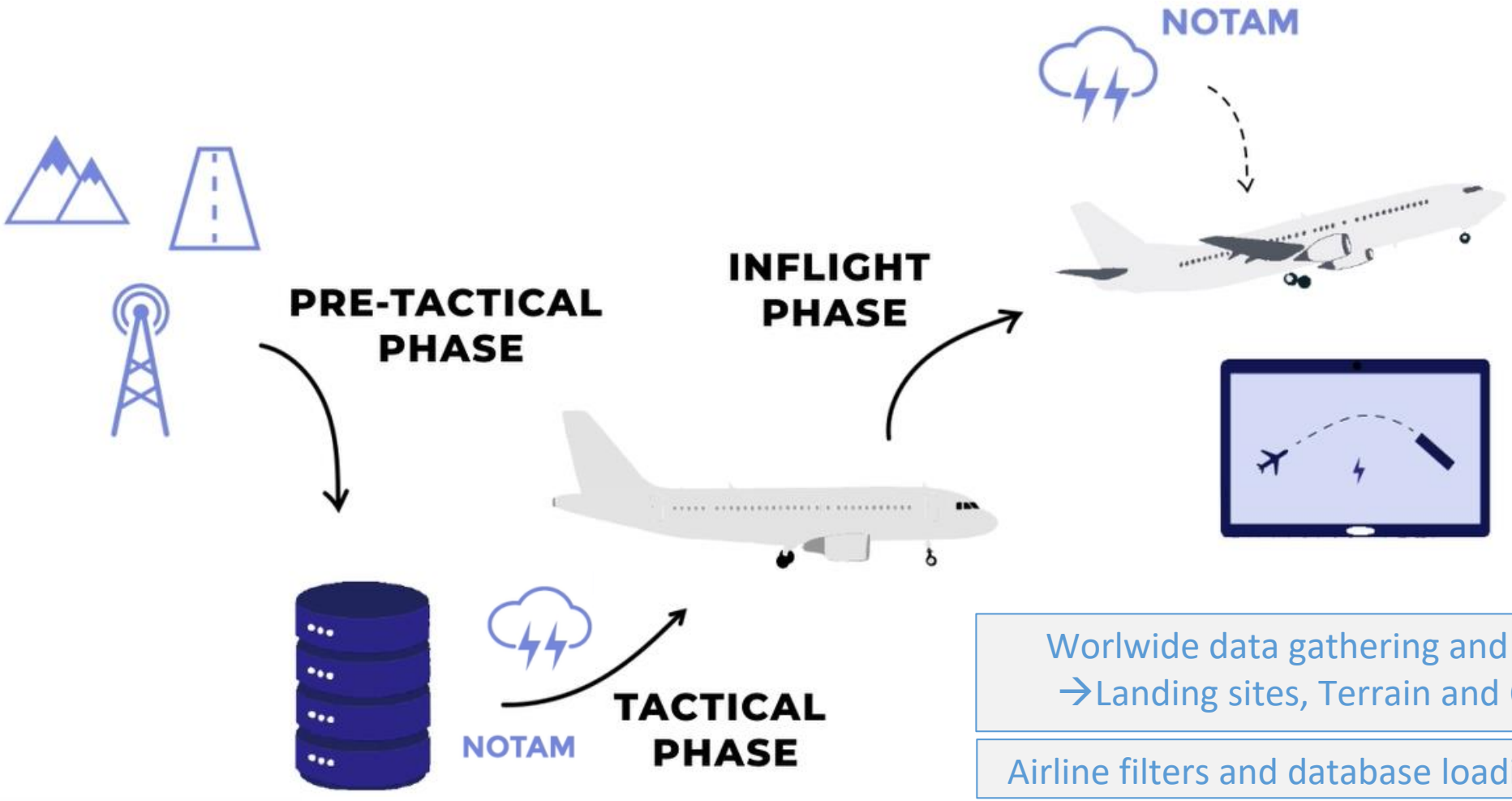
SAFENCY: INTRODUCTION

Operational Context – Air Traffic Management



SAFENCY: THE CONCEPT

SafeNcy phases



AVIATION CIVILE SERVICES
Expertise and Consultancy Office of the French Civil Aviation

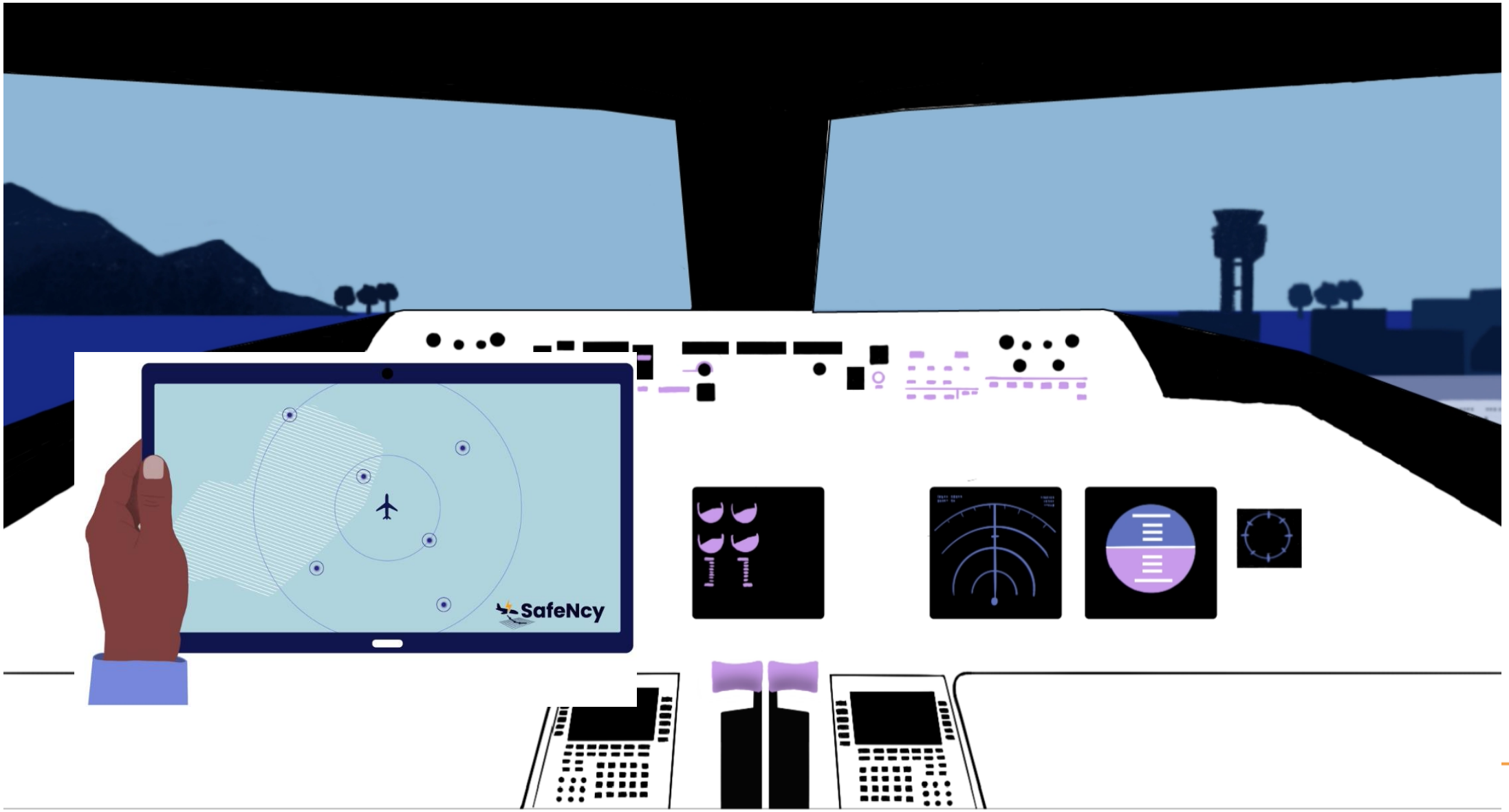
Worlwide data gathering and validation
→Landing sites, Terrain and Obstacles

Airline filters and database loading on-board

On-board landing site system and trajectory generator

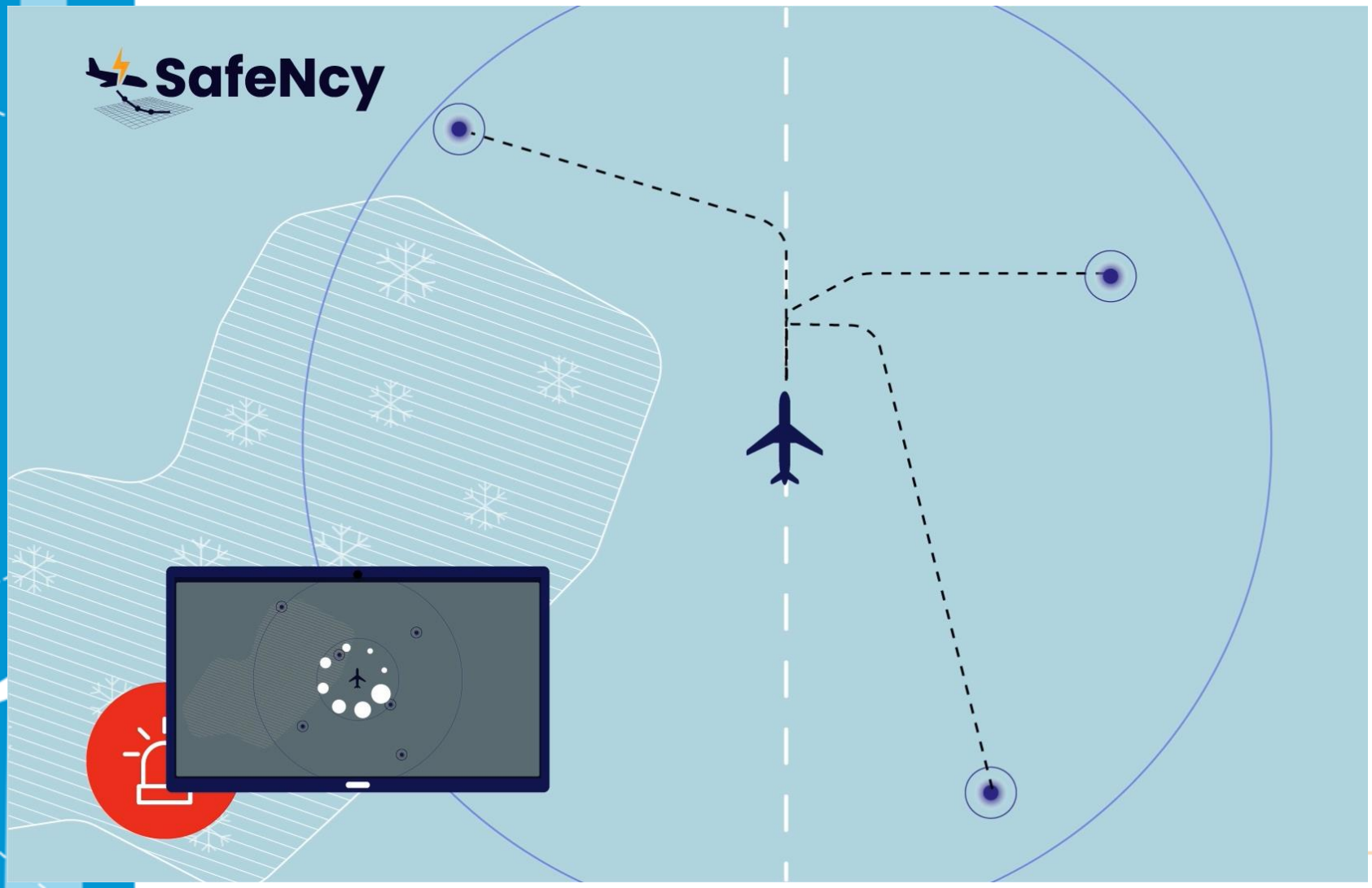
SafeNcy: The Concept

Operational Concept



SAFENCY: THE CONCEPT

Operational Concept – Emergency Management



Emergency mode is triggered either by the pilot or by the aircraft itself

SafeNcy selects the best landing sites/trajectories in function of the emergency and the aircraft performances

If the Flight Crew is satisfied with this best landing site proposed by SafeNcy, it validates it.

Otherwise, it keeps the possibility of choosing another one

Automatic communication of landing site information to ATC is ensured

SafeNcy keeps running in the background to adapt the landing solution to the evolving situation

SAFENCY: THE PROJECT

Trajectory Generation

- Current state of the aircraft
- Type of emergency
- Landing Site / PinS (/ Flight Procedure)
- Constraints (Terrain, Obstacles, Weather)

Input Parameters

Path Bound Generator

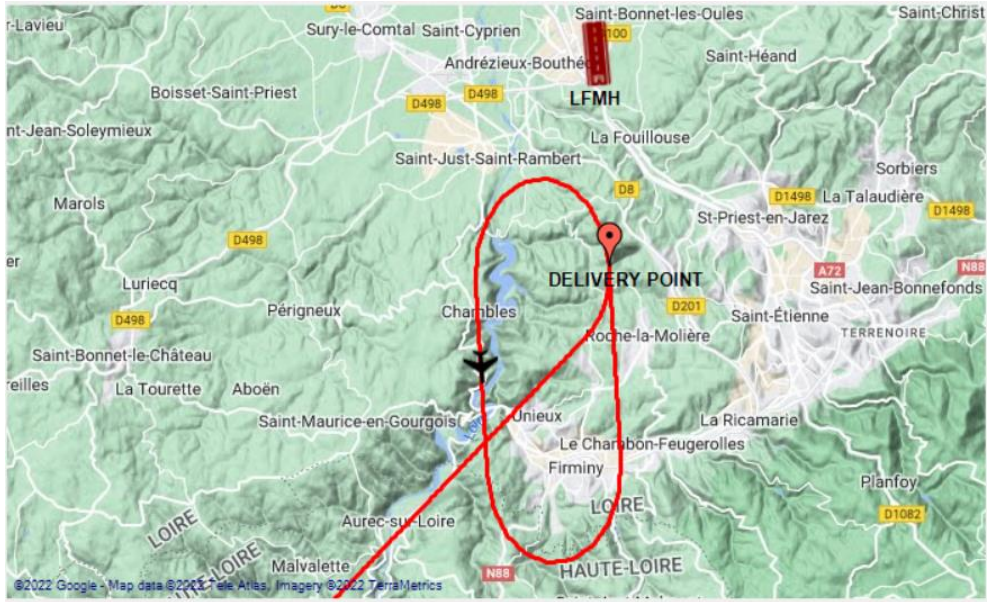
(min, max) Flight Envelopes

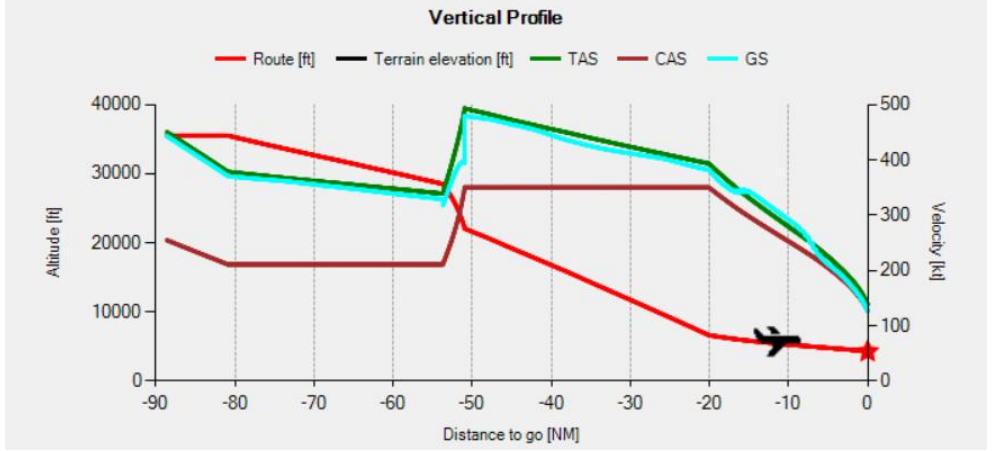
Path Generator

3D Trajectories

Motion Planner

4D Trajectories





FRANCE AVIATION CIVILE SERVICES

Expertise and Consultancy Office of the French Civil Aviation

SAFENCY: THE PROJECT

Safety Study

- FLIGHT SAFETY OPPORTUNITIES
- GAP ANALYSIS
- RISK ASSESSMENT
- ACTION PLAN
- SAFETY INDICATORS
- CONCLUSION

Conducted by pilots, Safety experts and confronted to SafeNcy developers

Safety Risk	Severity				
Probability	Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent 5	A5	B5	C5	D5	E5
Occasional 4	A4	B4	C4	D4	E4
Remote 3	A3	B3	C3	D3	E3
Improbable 2	A2	B2	C2	!D2	E2
Extremely improbable 1	A1	B1	C1	D1	E1

Safety Risk Index Range	Safety Risk Description	Recommended Action
A5, B5, C5, A4, B4, A3	INTOLERABLE	Take immediate action to mitigate the risk or stop the activity. Perform priority safety risk mitigation to ensure additional or enhanced preventative controls are in place to bring down the safety risk index to tolerable.
D5, E5, C4, D4, E4, B3, C3, D3, A2, B2, C2, A1	TOLERABLE	Can be tolerated based on the safety risk mitigation. It may require management decision to accept the risk.
E1, D1, E1, B1, C1, D1, E1	ACCEPTABLE	Acceptable as is. No further safety risk mitigation required.

SafeNcy, as a whole, improves the global safety of the flight.

- Better situation awareness allowing pilots to take the right decision.
- Final decision and responsibility shall remain with the flight crew.
- Complexity of a real emergency makes it a difficult challenge
- Need for safety margins for each calculation.
- The risk of SafeNcy leading the crew into a dead end will be considered acceptable.

FRANC AVIAT SERVICES

Expertise and Consultancy Office of the French Civil Aviation

SAFENCY: THE VALIDATION PROCESS

Validation Scenarii

- ANSA, ASAP, TEFO emergency
  - Validate SafeNcy proposal
  - Start diversion as proposed by SafeNcy then change
  - Diversion with high terrain on the direct trajectory
  - Diversion with severe weather on the direct trajectory
- Degradation of the situation
  - ANSA to become ASAP or TEFO, ASAP to become TEFO
  - No runway in reach => Off-airport Landing
- Circumstances
  - Remote area
  - Oceanic flight
  - ETOPS like situations
  - Time limitation (ASAP,fuel,…)

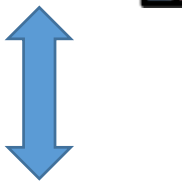
SAFENCY: TOPICS TO TACKLE

Some topics for ICAO also

- Integration into avionics / Compatibility with FMS and Autopilot / Certification
- Data exchanges between ATC and aircraft
- Embedded data
  - Data Quality Requirements
  - Certification
  - On-board loading and updates during the flight
  - Focus on remote areas
- Visualization of the solutions
  - The flight crew shall analyze instantaneously the proposed landing sites ans its environment
  - How can the flight crew select the solution?
  - How to display the solution into ATC systems?

FRANCE
AVIATION CIVILE
SERVICES
Expertise and Consultancy Office of the French Civil Aviation

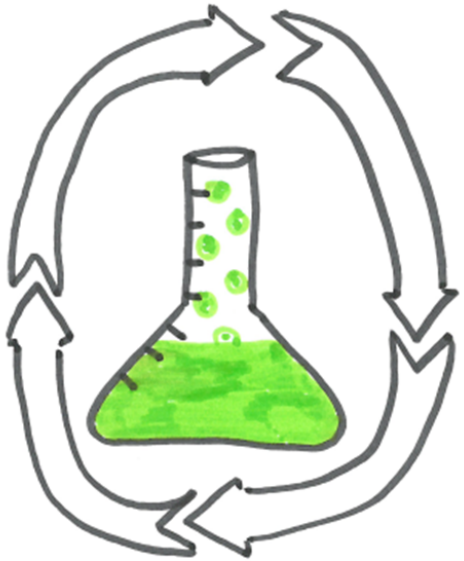
SAFENCY: THE INNOVATIVE PROCESS



Expertise and Consultancy Office of the French Civil Aviation

Research Process

Iterative process involving an Advisory Board



Preliminary works : State of the art / Use cases definition / Trade-off report

Landing site generator
- Data Sources study
- Ground component
- Onboard component

Trajectory generator
- Path Planner
- Motion Planner

Independent Validation

Independent Validation

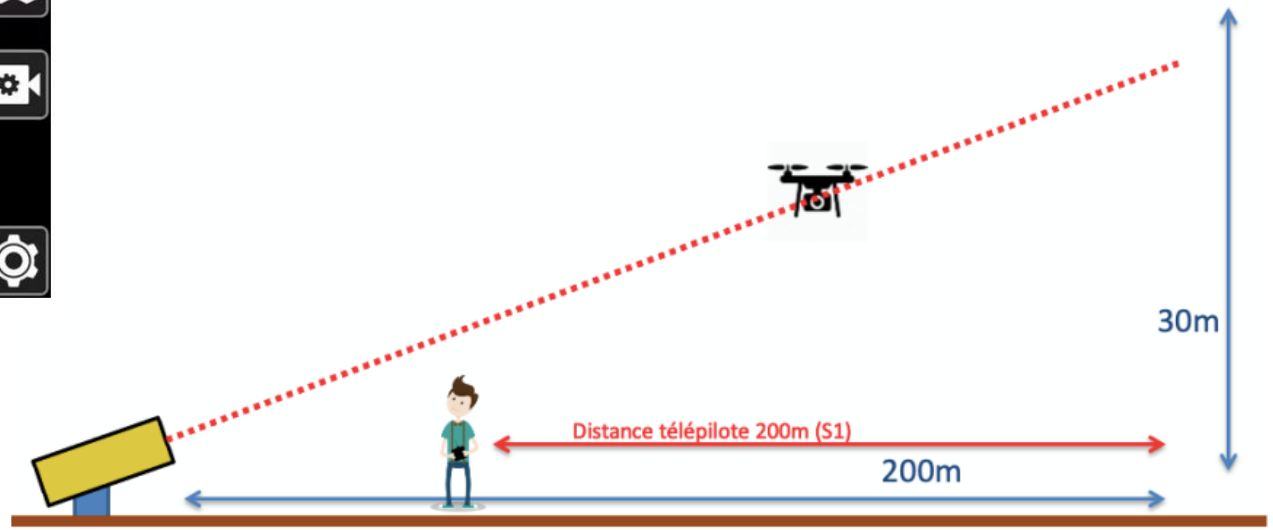
Integration / Validation in an Ad-Hoc Simulator / DIADEME

Safety Assessment

PAPI Calibration with Drones

PAPI Calibration using Drones

- Automatic Real-Time Detection of colour transition based on image processing algorithms
- Advantage : Allows real time tuning



FRANCE AVIATION CIVILE SERVICES
Expertise and Consultancy Office of the French Civil Aviation

PAPI Calibration using Drones

- Easy and Quick to implement
- Reduced runway occupancy time (about 1 hour per PAPI set)
- Very good accuracy
- Few restrictions on the activity
- Competitive cost

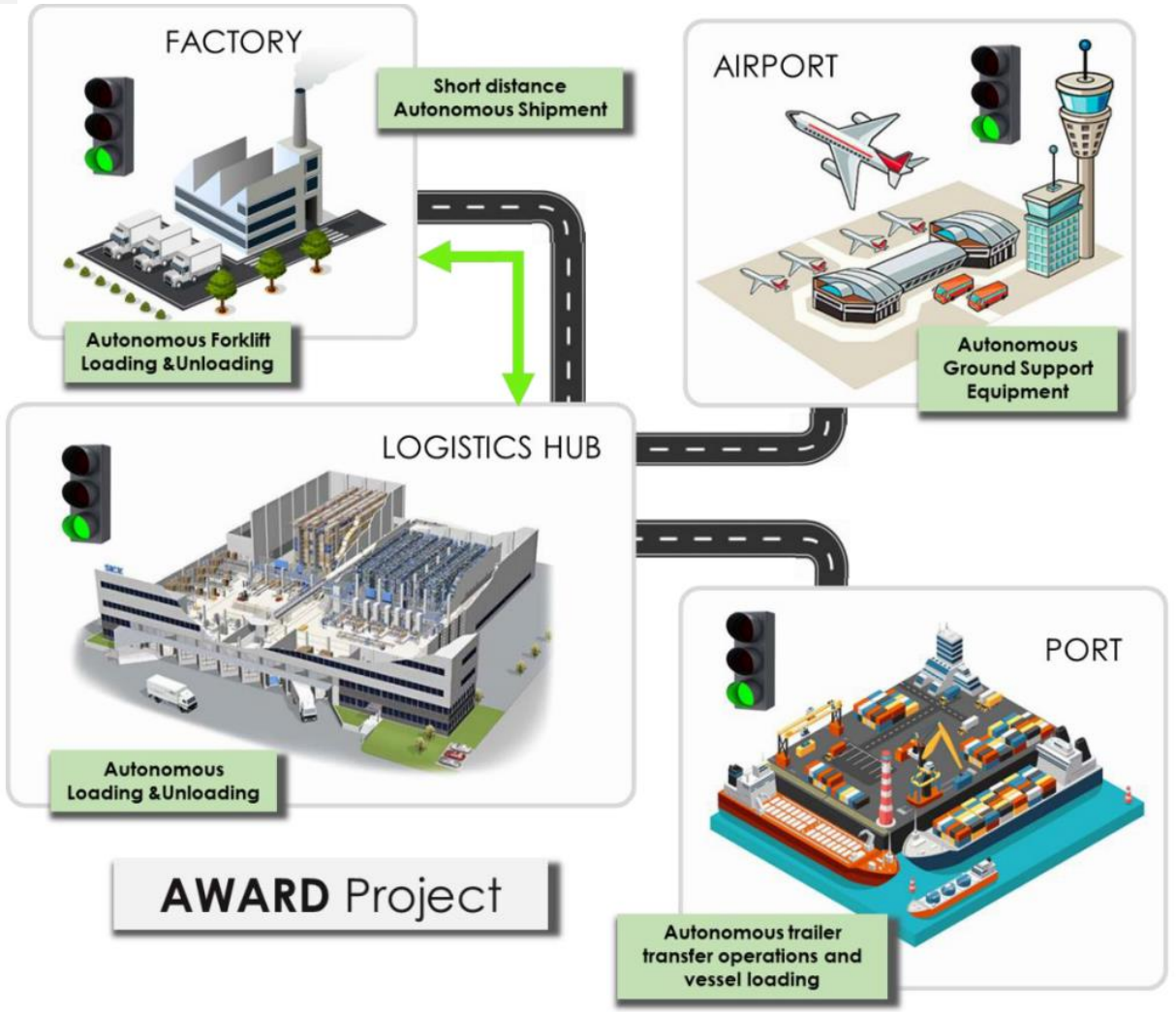
FRANCE AVIATION CIVILE SERVICES
Expertise and Consultancy Office of the

- *ADS-B equipped Drone*
- *Emergency landing in a few seconds (RTH auto)*
- *Geofencing implemented*
- *Drone and frangible material*

AWARD

AWARD: All Weather Autonomous Real logistics operations and Demonstrations

- Developing and operating safe autonomous transportation systems (ATS) in a wide range of real-life logistic use cases in a variety of different scenarios
- Handling adverse environmental conditions such as heavy rain, snowfall, fog.
- Variety of real-life use cases to validate their value in the application and identify any limitations:
  - forklift loading and unloading in warehouses and industrial plants,
  - hub-to-hub shuttle service on open road,
  - automated baggage dispatching in airports,
  - container transfer operations and vessel loading in ports.



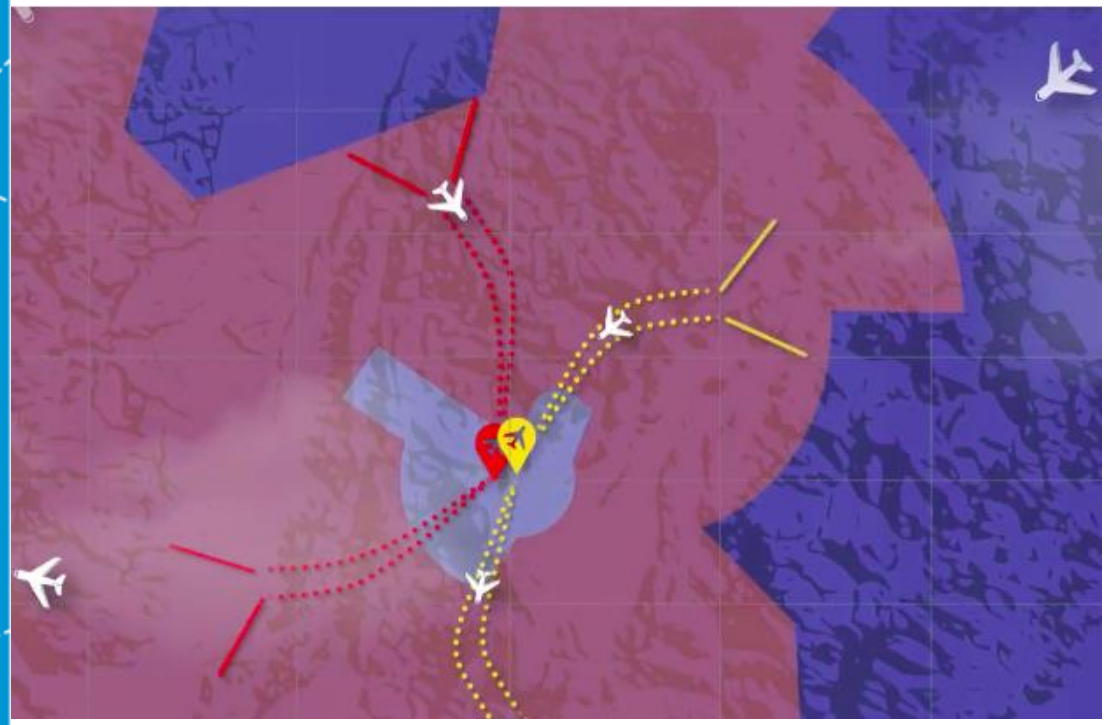
AWARD: FRACS ROLE

- *Develop a Risk based methodology to manage safety for Autonomous vehicles on Airport*
- *Consider existing regulations and future Regulatory development to allow Safe implementation of Autonomous Vehicles on Airports*

DIADEME


Diademe
Provide the ability to design and assess airspace performance

AIRSPACE PERFORMANCE



FRANCE
AVIATION CIVILE
SERVICES
Expertise and Consultancy Office of the French Civil Aviation

A CONTINUOUS CHALLENGE

REINFORCED BY

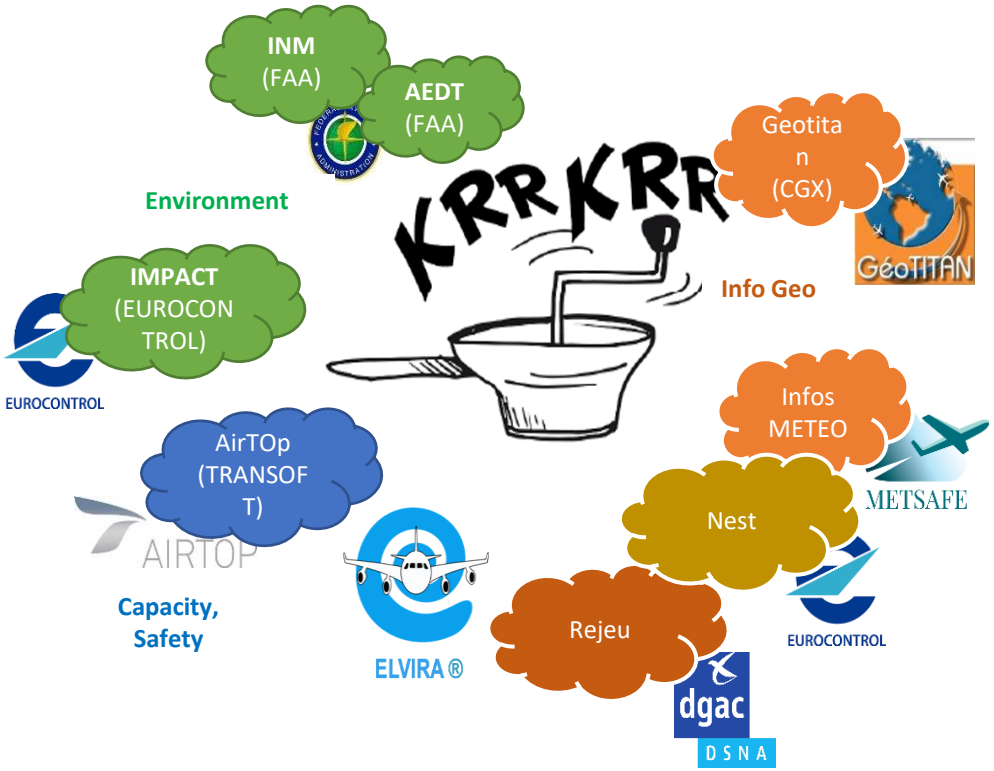
ENVIRONMENTAL NEEDS

Safety

Capacity

Environment

TODAY



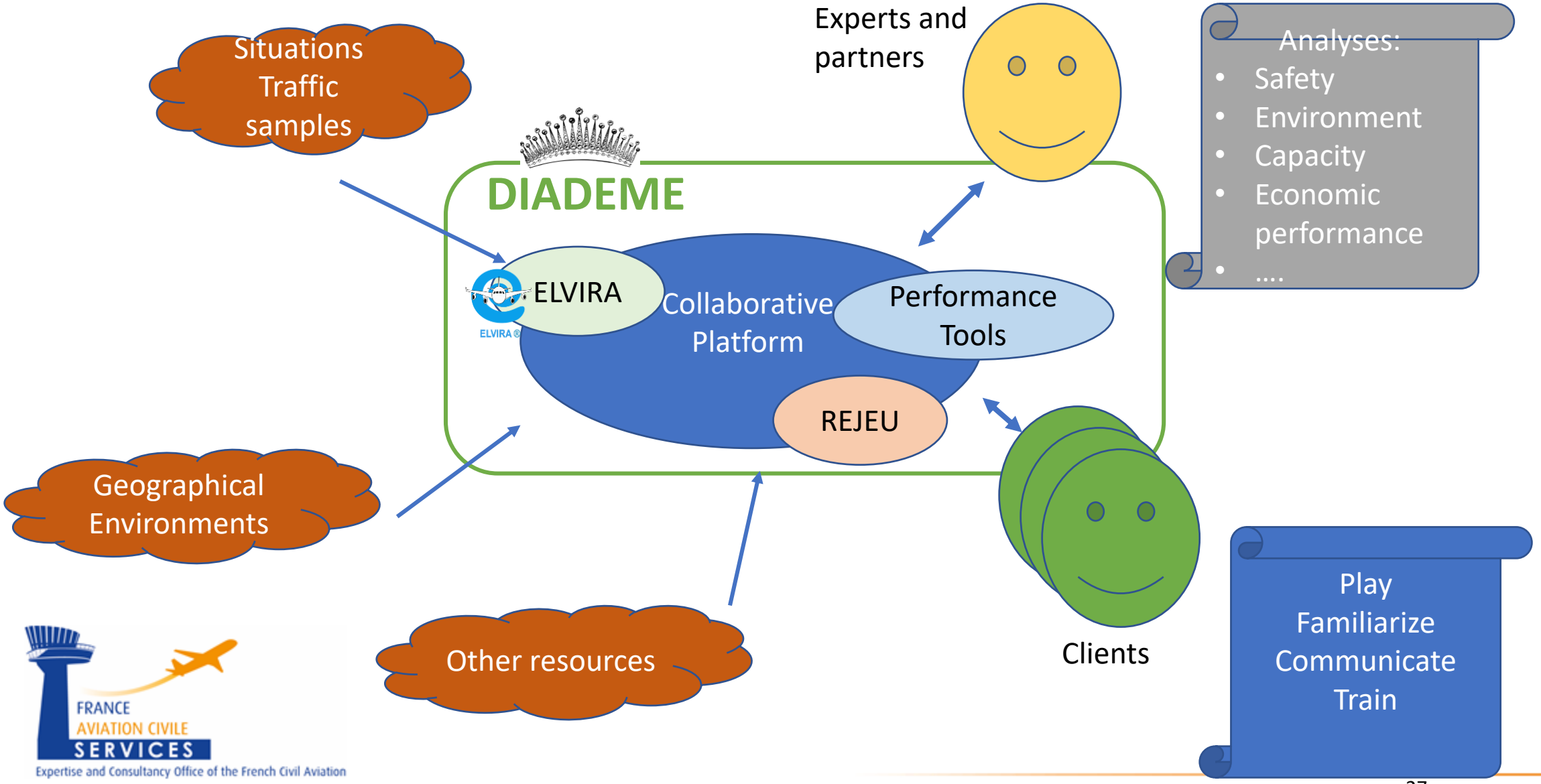
FRANCE
AVIATION CIVILE
SERVICES
Expertise and Consultancy Office of the French Civil Aviation

10 months

Medium term

Long term

A collaborative tool for experts, partners and clients of an airspace design project



Essential at every stage of the process of developing and optimizing an airspace

Initial step

Surveillance data

ADS-B data

Capturing initial environment

Situation analysis
Performance modeling and analysis

- Identification of challenges and objectives of the study
- Working method definition: different steps or scenarios

At each step

Tuning the airspace system

- Operational concept
- Regulation
- ATC methods
- Procedure design
- Sectorization

Analysis of the system
Performance modeling and analysis

- Safety
- Capacity
- Operational efficiency
- Acceptability
- Workload
- Environment
- Economical aspects
- …

Final step

Finalising the airspace system

Analysis of the system
Performance modeling and analysis

DIADEME

Demos

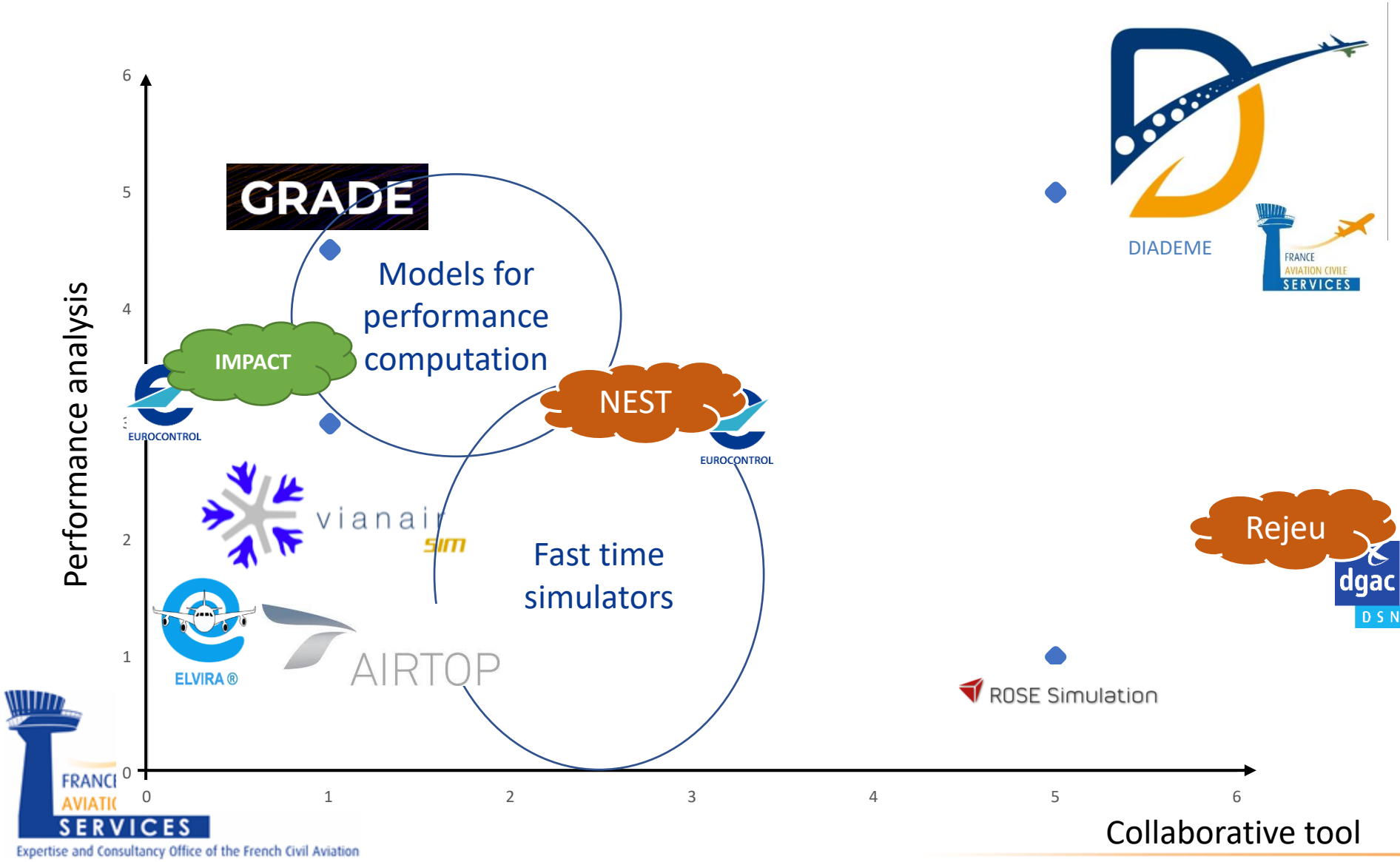
Final report

Cartography and publications

Performance Results

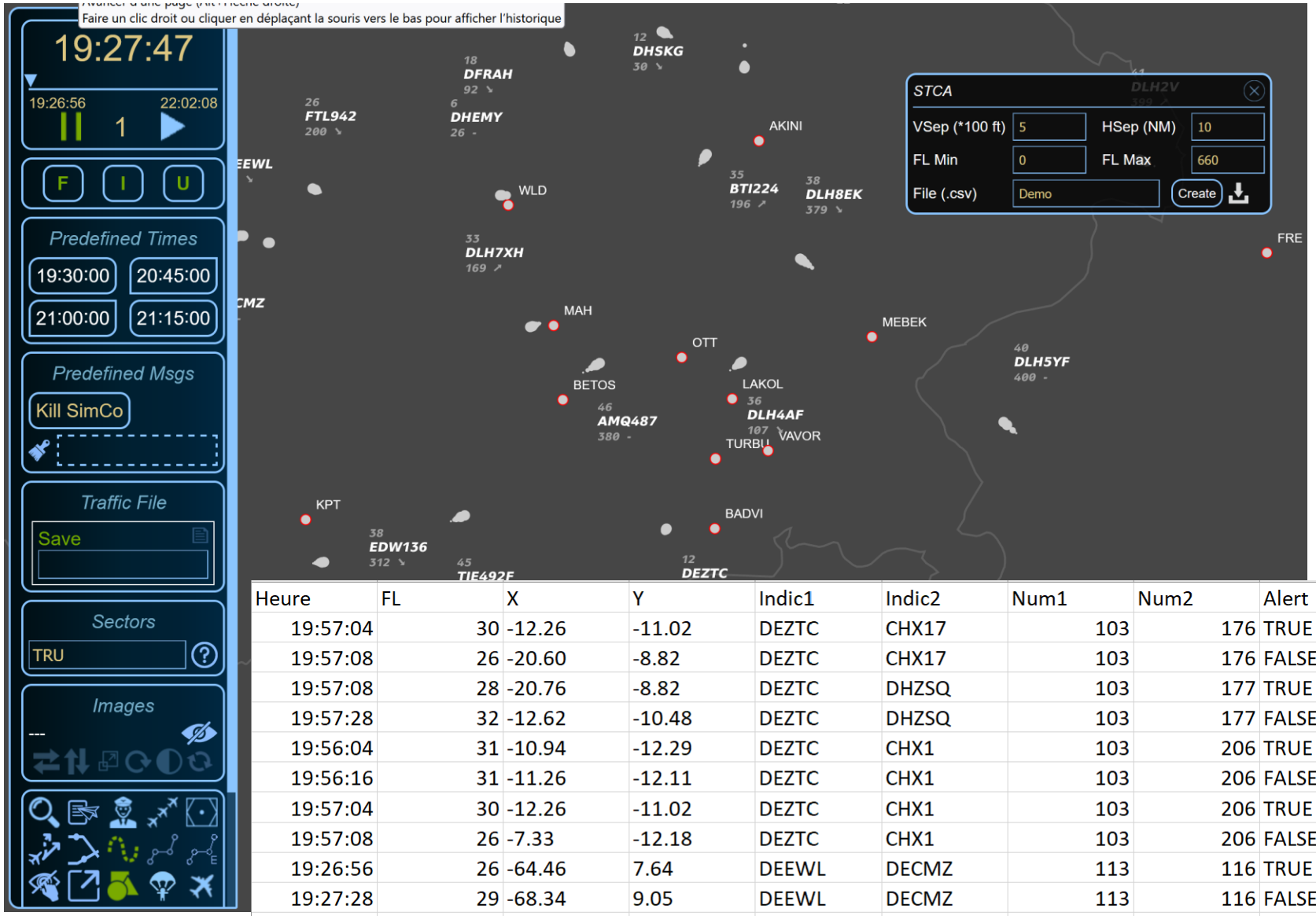
Metadata exports

DIADEME : A UNIQUE POSITIONING



SAFETY

- STCA as an option
- Traffic analysis
  - Select Separation Minima
  - Get all loss of separation of the traffic sample

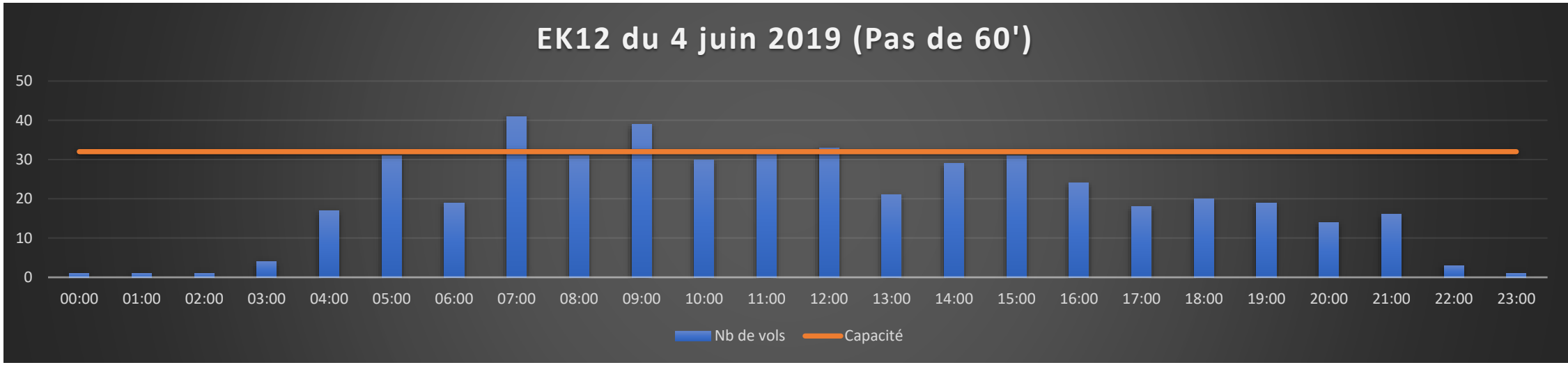


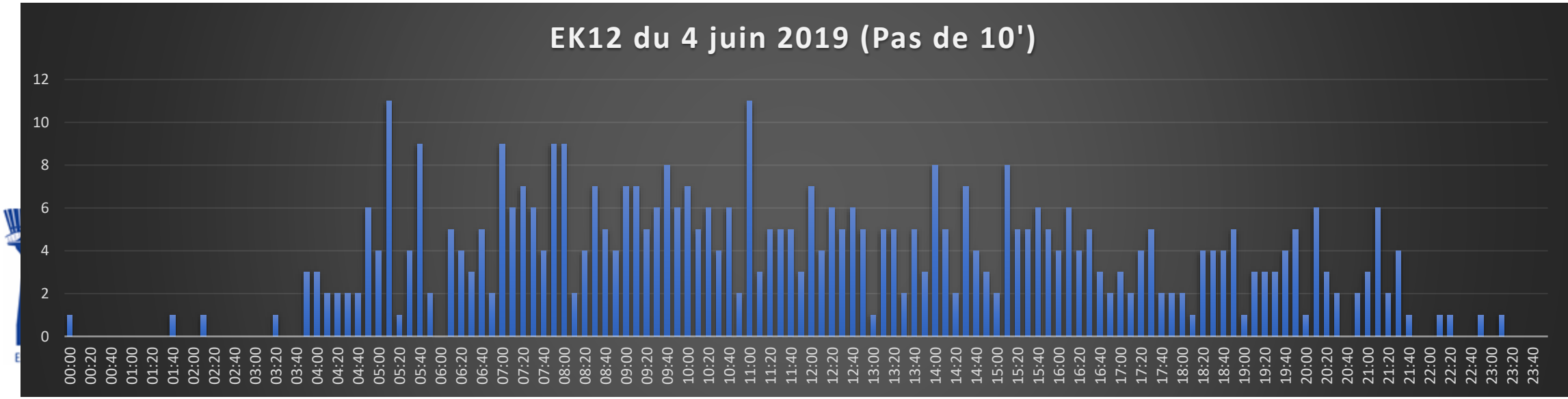
Heure	FL	X	Y	Indic1	Indic2	Num1	Num2	Alert
19:57:04	30	-12.26	-11.02	DEZTC	CHX17	103	176	TRUE
19:57:08	26	-20.60	-8.82	DEZTC	CHX17	103	176	FALSE
19:57:08	28	-20.76	-8.82	DEZTC	DHZSQ	103	177	TRUE
19:57:28	32	-12.62	-10.48	DEZTC	DHZSQ	103	177	FALSE
19:56:04	31	-10.94	-12.29	DEZTC	CHX1	103	206	TRUE
19:56:16	31	-11.26	-12.11	DEZTC	CHX1	103	206	FALSE
19:57:04	30	-12.26	-11.02	DEZTC	CHX1	103	206	TRUE
19:57:08	26	-7.33	-12.18	DEZTC	CHX1	103	206	FALSE
19:26:56	26	-64.46	7.64	DEEWL	DECMZ	113	116	TRUE
19:27:28	29	-68.34	9.05	DEEWL	DECMZ	113	116	FALSE
19:30:16	16	-60.11	9.23	DEEWL	DECMZ	113	116	TRUE
19:30:32	16	-59.91	9.41	DEEWL	DECMZ	113	116	FALSE
19:30:44	16	-59.75	9.47	DEEWL	DECMZ	113	116	TRUE

FRANCE AVIATION CIVILE SERVICES
Expertise and Consultancy Office of the French Civil Aviation

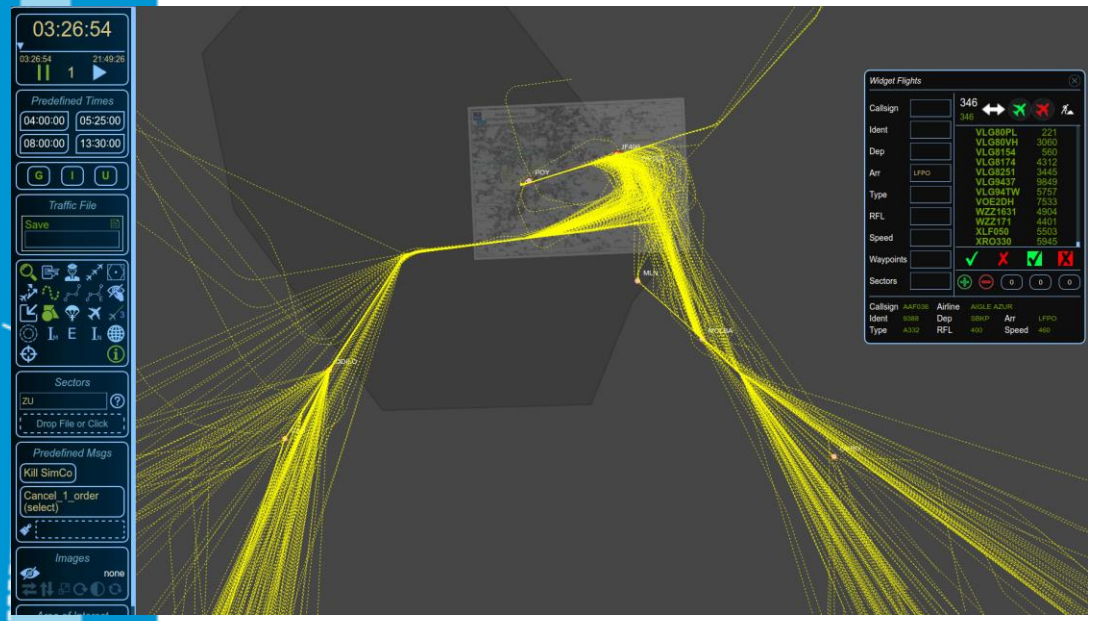
CAPACITY: SECTOR LOAD MEASUREMENT

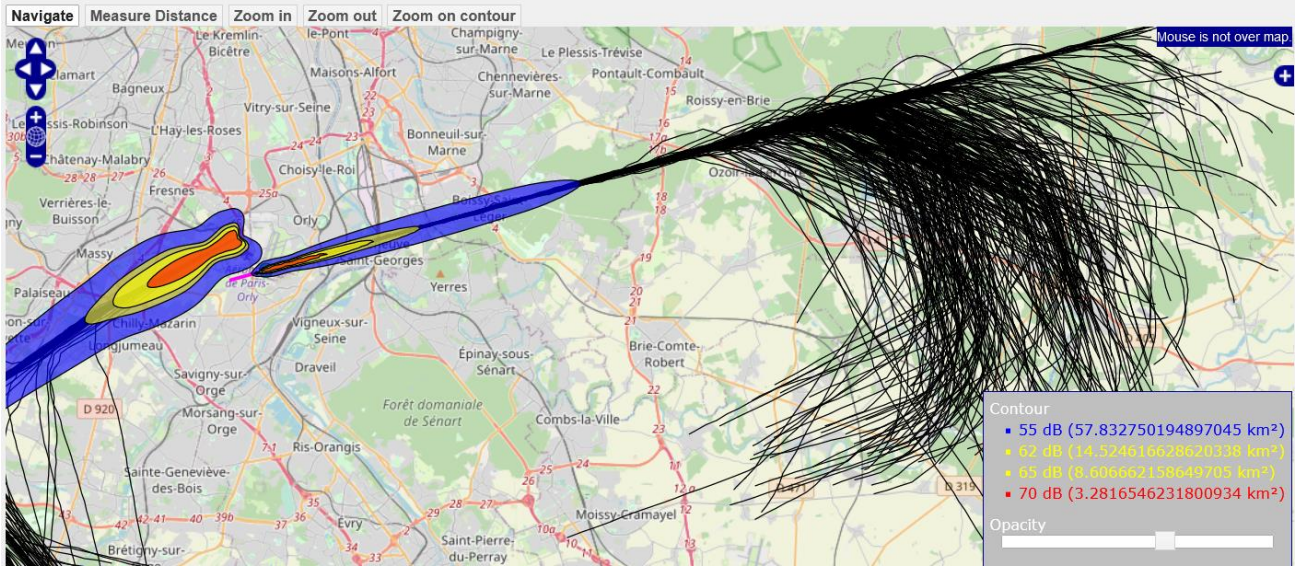
Marseille ACC- PROVERT Project

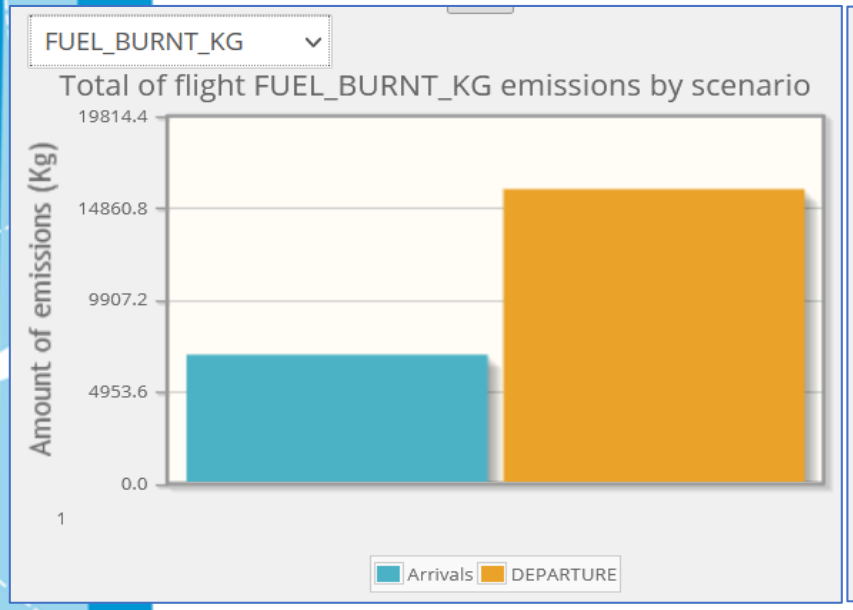


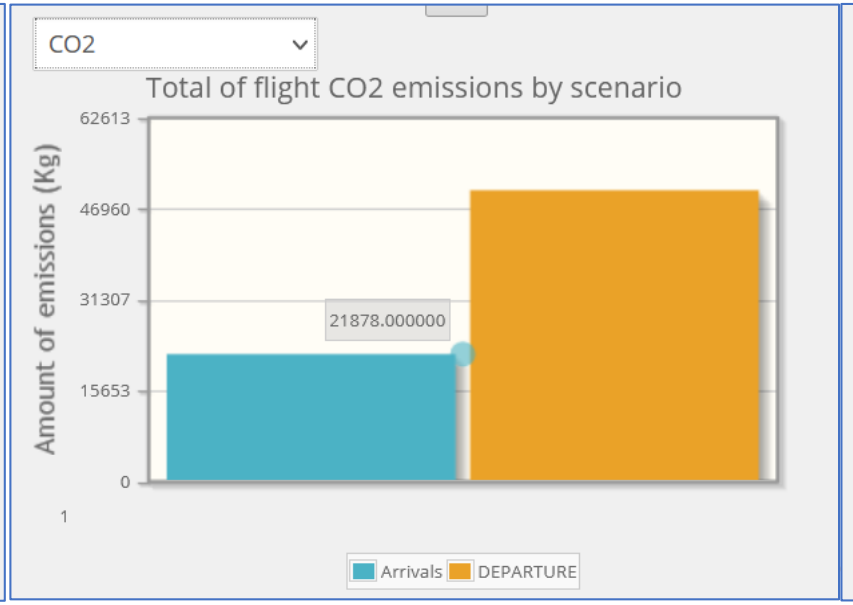


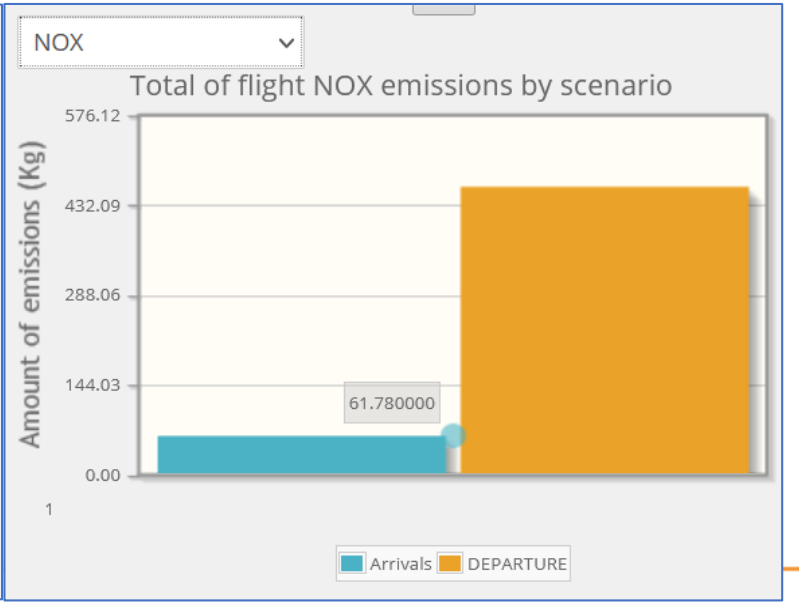
PROOF OF CONCEPT: NOISE STUDY CONDUCTED WITH DIADEME







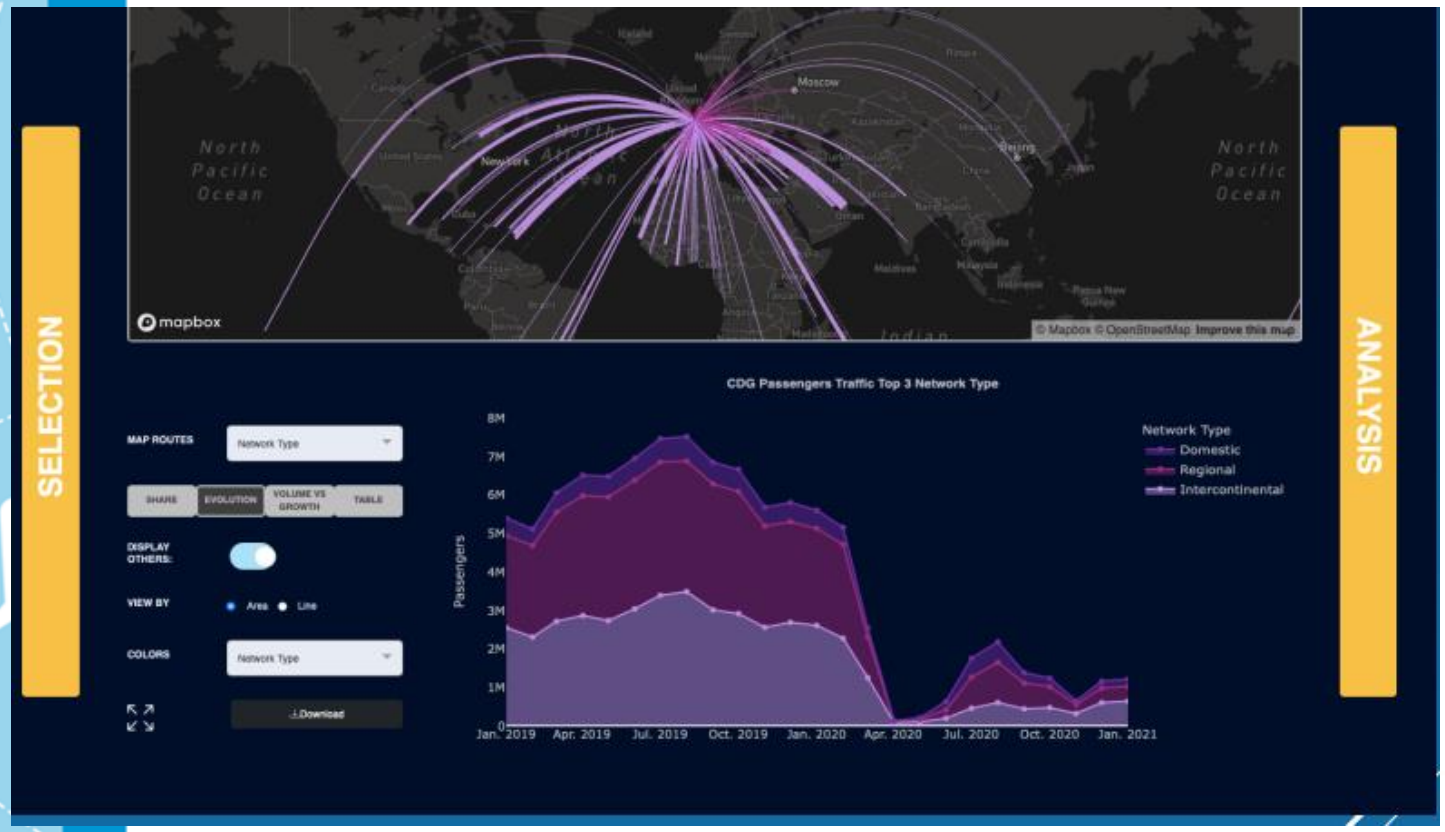




ATD Analytics

ATD Analytics

- Born from our Air Transport Databases
  - 3 Databases
    - Airlines
    - Airports
    - Traffic flows
  - Worldwide
  - More than 30 years of data history



- Created in October 2021 in partnership with ALMAZ Aviation

- 3 Tools in one
  - A comprehensive database of traffic flows over the past decade
  - A visualization tool to understand and analyze the data.
  - An innovative strategic development tool

METEOR

The application for Supervisory Authorities

METEOR Objectives

A common internet platform compatible with all disciplins, usable by supervisory authority and the bodies supervised to :

- Facilitate exchanges for the planning of surveillance acts, the follow-up of findings or communication (regulations, procedures, guides, safety information or any other document)
- Centralize monitoring information
- Dematerialize data and exchanges between the authority and the supervised organizations

- Developed by the French Authority: DSAC

FRANCE
AVIATION CIVILE
SERVICES
Expertise and Consultancy Office of the French Civil Aviation

Manage your exchanges with organizations

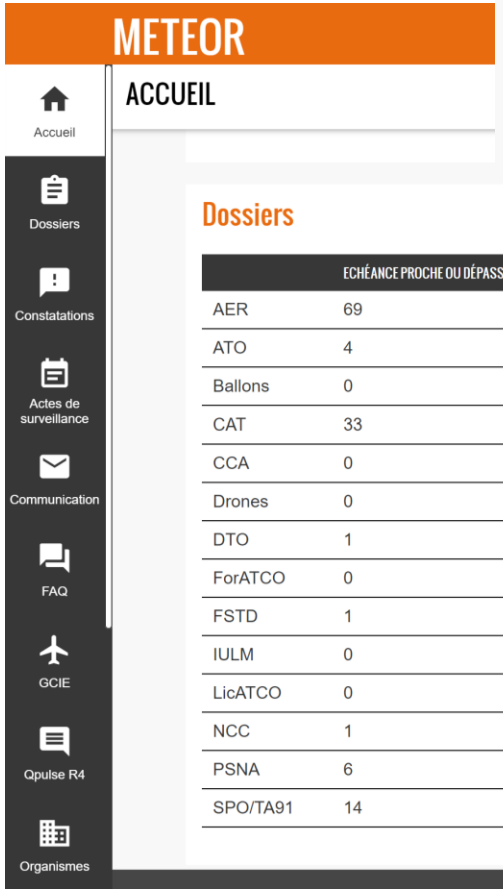
Thanks to METEOR you will be able to manage your:

- Communications
  - Allows you to create folders and attach the necessary documents
  - Allows you to propose comments, changes, give an opinion...
  - Allows exchanges on findings
  - Allows you to manage approvals/permissions
  - Allows the provision of guides, safety information, communication on the organization of symposia or seminars...
- Surveillance Acts
  - Allows the scheduling of different types of acts
  - Gives the possibility to attach the necessary documents
  - Allows annotations and comments, visible to organizations or internally only
- Findings
  - Transmission, proposal and acceptance of the corrective action plan, follow-up of the implementation of corrective actions, proof of compliance, conclusion...

FRANCE AVIATION CIVILE SERVICES
Expertise and Consultancy Office of the French Civil Aviation

Manage your performance

- Access to dashboards and consolidated information



Actes de surveillance

	EN ATTENTE DE RAPPORT	RAPPORT EN RETARD	A TRAITER
AER	110	96	35
ATO	31	30	7
Ballons	25	24	11
CAT	425	383	42
CCA	1	1	1
Drones	112	104	34
DTO	49	47	7
ForATCO	1	0	0
FSTD	0	0	0
IULM	3	3	1
LicATCO	0	0	0
NCC	11	9	5
PSNA	33	31	8
SPO/TA91	50	41	15

Organismes

	EN INSTRUCTION	EN SURVEILLANCE RENFORCÉE	ACTIFS	INACTIFS
AER	1	2	805	23
ATO	4	2	185	26
Ballons	0	0	182	36
CAT	5	2	109	66
CCA	0	1	13	3
Drones	-	-	10009	526
DTO	4	0	739	10
ForATCO	1	0	31	0
FSTD	1	1	42	3
IULM	2	0	36	7
LicATCO	-	-	29	0
NCC	0	0	73	15
PSNA	3	0	145	1
SPO/TA91	3	0	579	137

Dossiers

	ECHÉANCE PROCHE OU DÉPASSÉE	RÉPONSES À TRAITER	A VALIDER
AER	69	102	0
ATO	4	156	0
Ballons	0	1	0
CAT	33	233	0
CCA	0	8	0
Drones	0	4	0
DTO	1	38	0
ForATCO	0	41	0
FSTD	1	52	0
IULM	0	6	0
LicATCO	0	29	0
NCC	1	12	0
PSNA	6	27	0
SPO/TA91	14	61	0

Constatations

	BROUILLONS	ÉCHÉANCE PROCHE	ÉCHÉANCE DÉPASSÉE	À TRAITER	A VALIDER	NIVEAU 1
AER	76	156	2499	297	0	6
ATO	1	0	199	87	0	4
Ballons	8	0	116	33	7	1
CAT	52	0	304	43	3	2
CCA	0	0	4	2	0	0
Drones	27	0	79	0	0	14
DTO	0	1	200	27	0	0
ForATCO	9	0	3	0	0	0
FSTD	0	0	14	5	0	0
IULM	0	0	4	1	0	0
LicATCO	2	0	1	0	0	0
NCC	10	0	70	12	2	0
PSNA	8	20	220	31	0	0
SPO/TA91	23	0	168	25	4	2

FRANCE AVIATION CIVILE SERVICES
Expertise and Consultancy Office of the French Civil Aviation

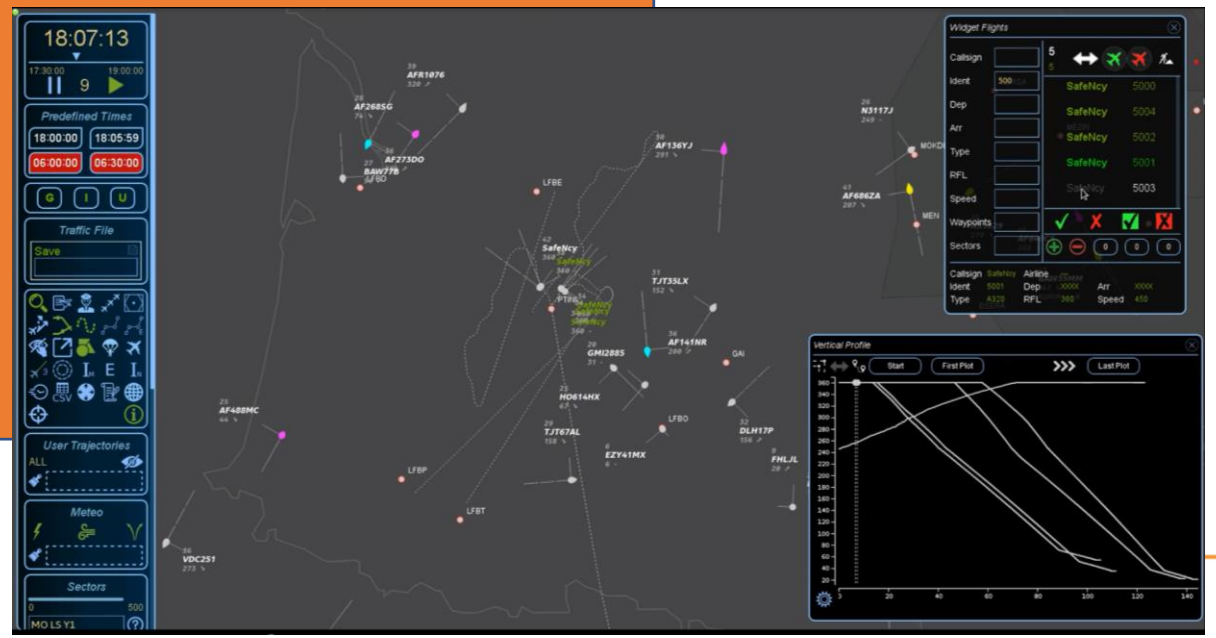
FRACS Innovative Approach

France Aviation Civile Services Innovative Approach

- Play Innovation for real, not for fashion
- Allow new ideas to take place on all sectors of activity
- Take benefit from innovation in one sector for another
- Combine innovative projects together
- Improve our working methods
- Focus on Implementation
- Open new avenues

FRANCE AVIATION CIVILE SERVICES

Expertise and Consultancy Office of the French Civil Aviation



One example of potential new avenues with DIADEME

- Training
  - Autonomous pedagogy "Try and see"
  - Comparing scenarios
  - Training-assessing
- Experimental
  - New control methods
  - PBN environmental benefits assessment
  - New aircraft types
  - Drone Insertion in airspace
  - ….

FRANCE
AVIATION CIVILE
SERVICES
Expertise and Consultancy Office of the French Civil Aviation

Some general considerations

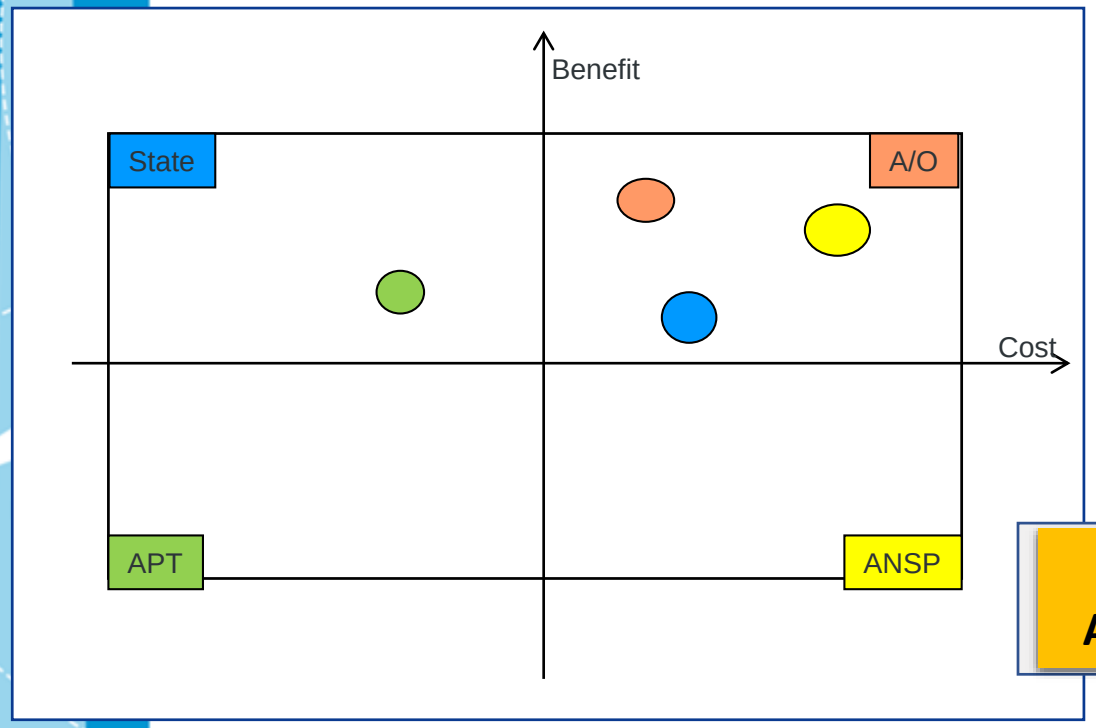
Timeliness of Innovation for Aviation Stakeholders

Considering a GANP Functional Capability

Aircraft Manufacturing: 15 Y+ 30Y life time

Rule Making process: 2 Y

ICAO ?



Buy, Train, Operate: 3 Y

Buy, Train, Operate: 5 Y

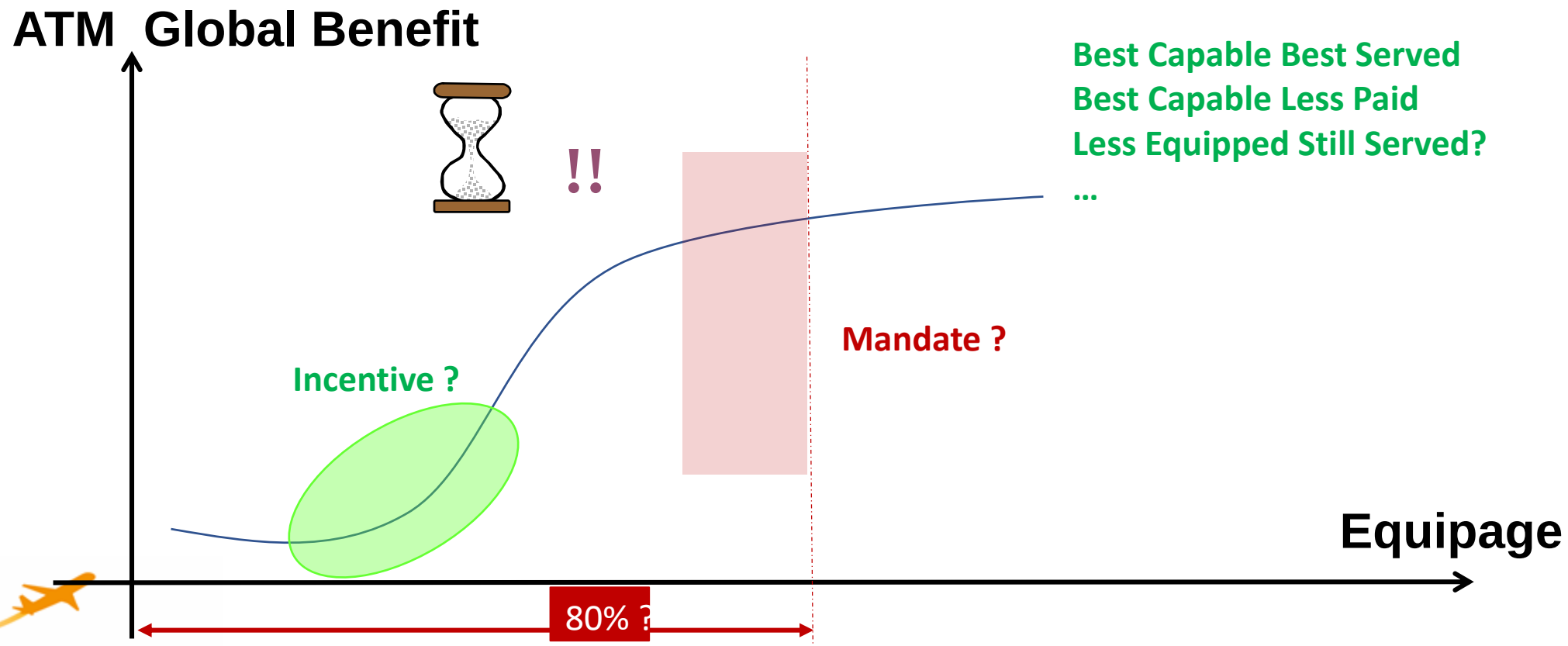
Buy, Train, Operate: 3 Y

A real need for a coordinated Approach
Actions from all for a global or common benefit

How to transform Innovation in Real Value for Aviation?

Incentivising real innovative implementation?

or Let Benefit speak for itself



FRANCE AVIATION CIVILE SERVICES
Expertise and Consultancy Office of

Benefits in ATM go with equipage homogeneity

Conclusion

- We try to take our part of Aviation Sustainable development through practical innovation on various projects
- Innovation is allowing us to progress in our working methods
- We focus on cooperative approach, access and implementation

INNOVATION
WORKSHOP

ICAO

www.fracs.aero

THANK YOU!

FRANCE
AVIATION CIVILE
SERVICES
Expertise and Consultancy Office of the French Civil Aviation