



PBN

AIRSPACE CONCEPT WORKSHOP

**Airspace Concept Handbook
Overview**



**Federal Aviation
Administration**





Airspace Concept Handbook
for the Implementation of
Performance Based Navigation (PBN)



Federal Aviation
Administration





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1. Background Information
2. Airspace Concept Development
3. Airspace Concept Validation
4. Implementation
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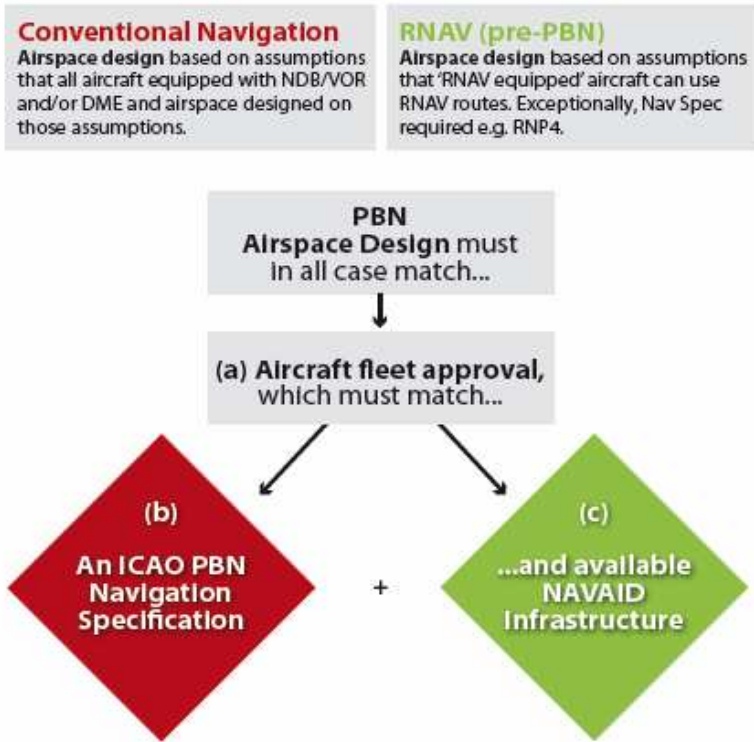
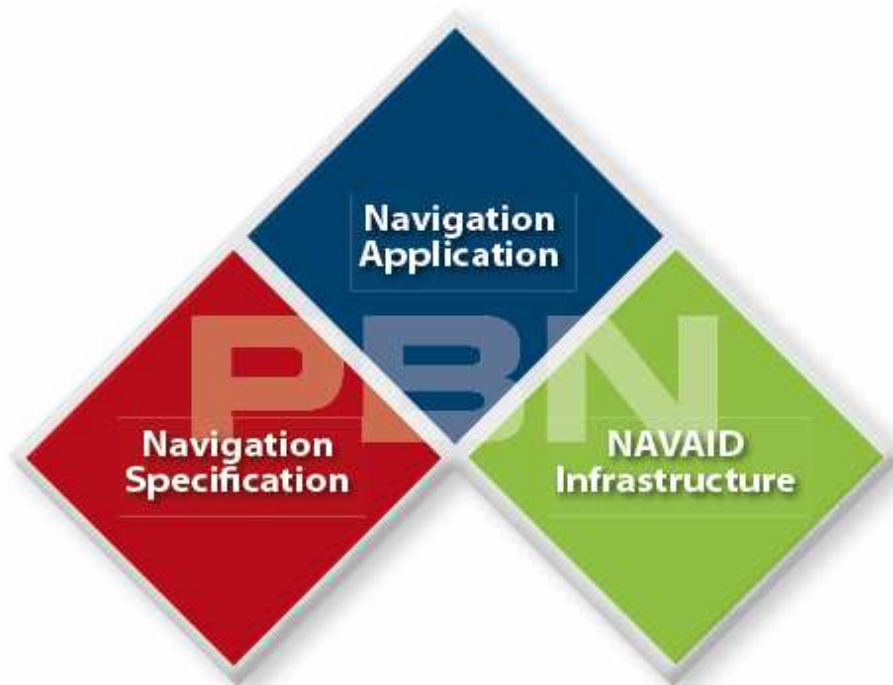
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Background Information



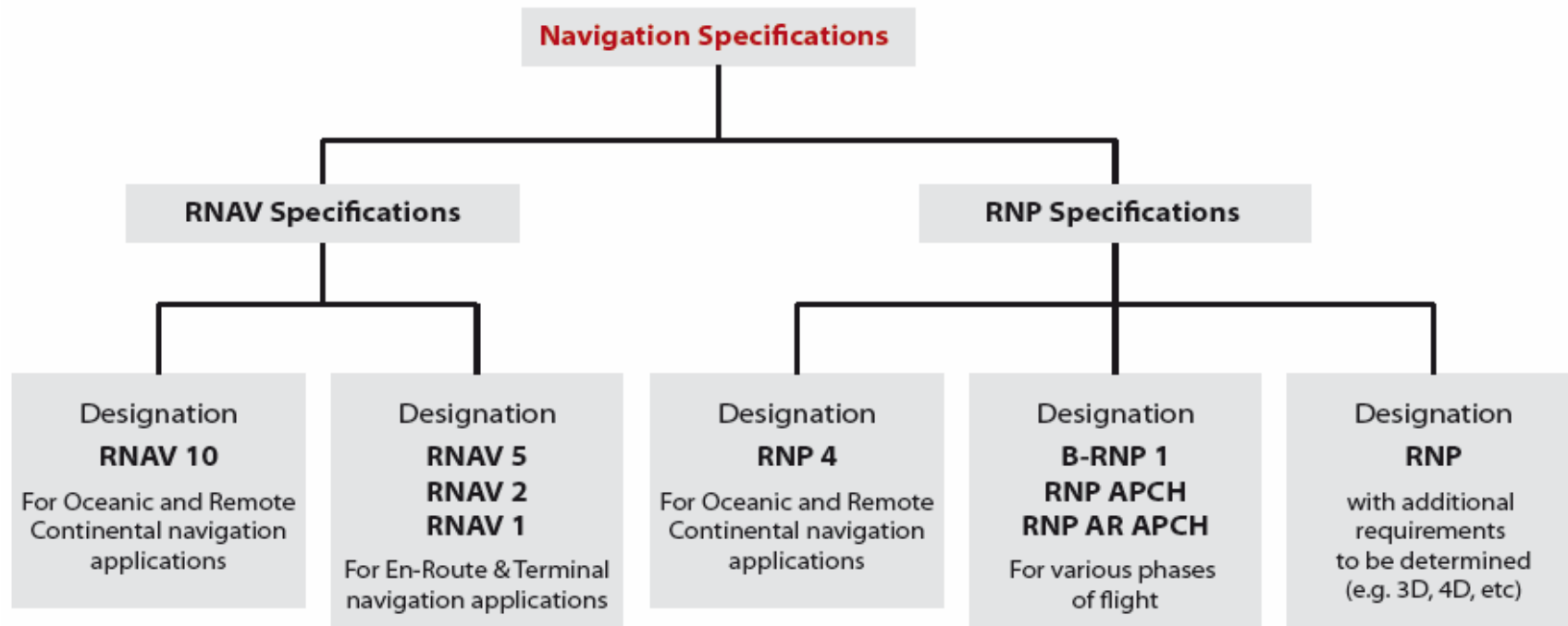


PBN





NAV SPECS





AIRSPACE CONCEPT

AIRSPACE CONCEPT

Assumptions: CNS/ATM/Traffic/RWY/MET

Airspace Design
Routes;
Volumes;
Sectors.

Inter-centre letters of Agreement

Traffic assignment
[incl. regulation]

Special techniques
CDA; Point Merge

Flexible Use of Airspace
Airspace Classification

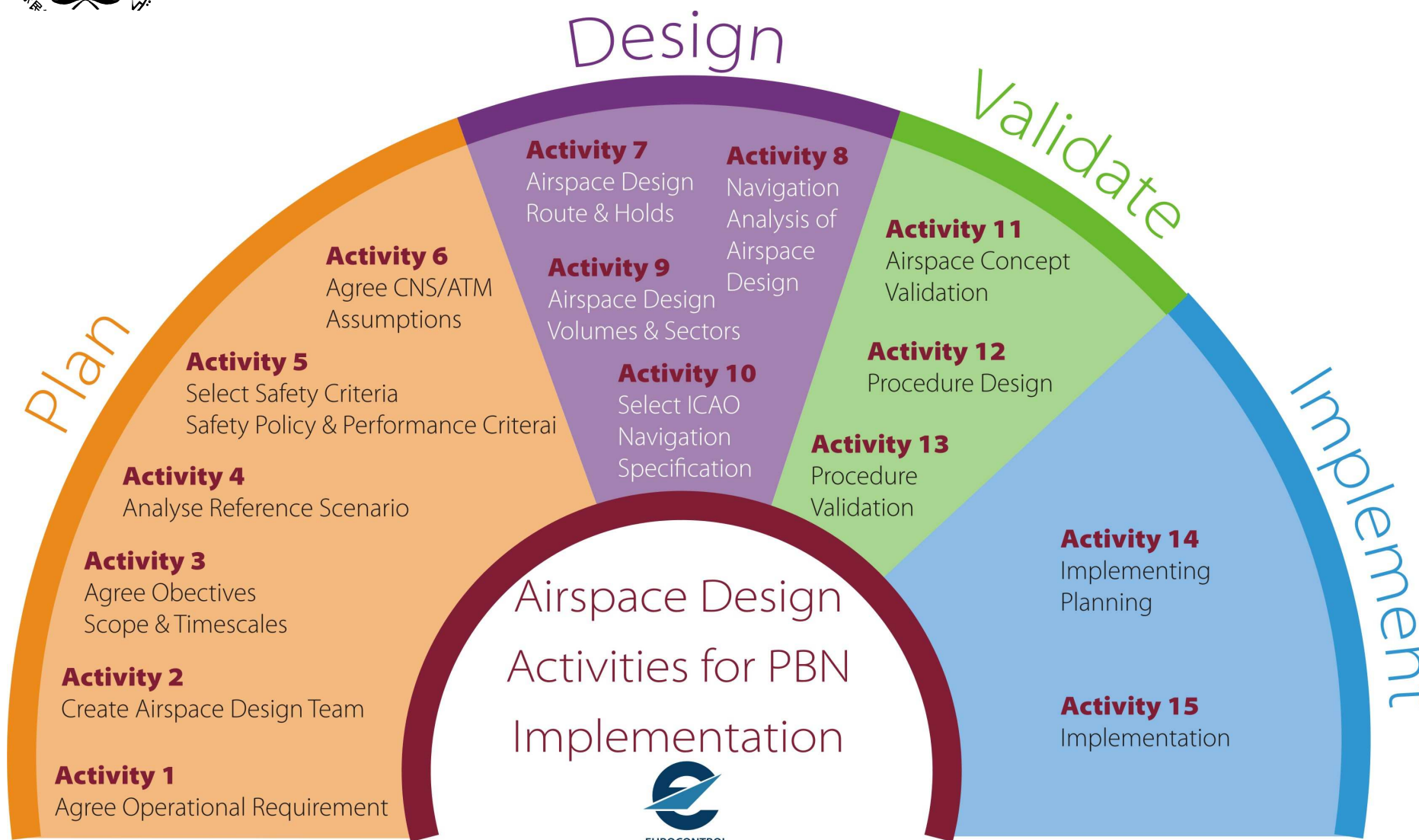




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Airspace Concept Development







Activity 1 (P1)

1 - Agree on Operational Requirements

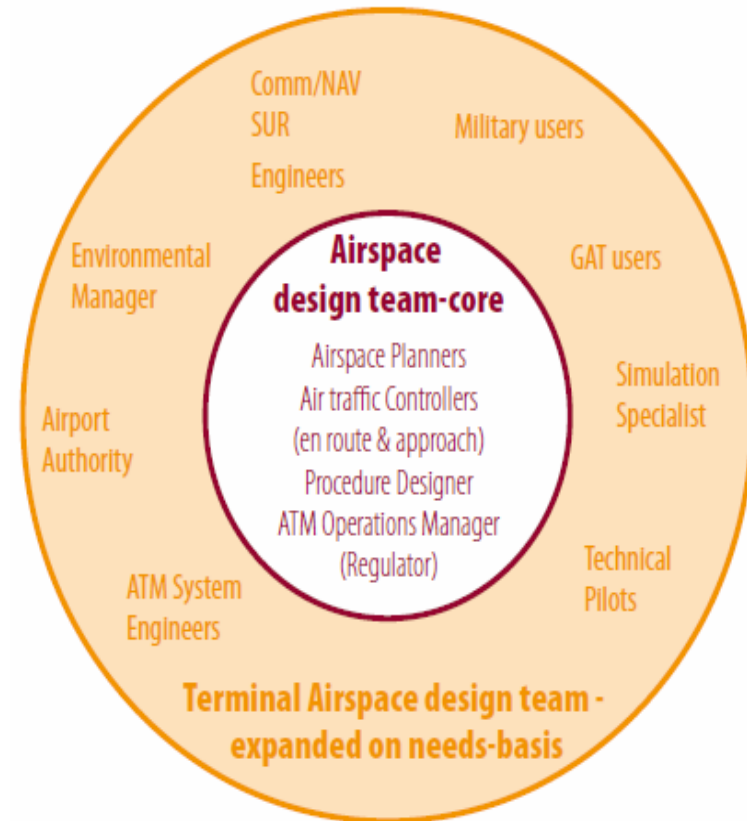
- Capacity
- Environment
- Accessibility
- Safety
- Efficiency



ACTIVITY 2 (P1)

2 – Create Airspace Design Team

- ✈ Lead by ATM/airspace specialist
- ✈ ATC (Approach and Area controllers)
- ✈ ATM & CNS specialist
- ✈ Procedure designers
- ✈ Technical pilots
- ✈





Activity 3 (P1)

3 – Project objectives, scope and timescales

- Objective derived from Ops requirements
- Scope !! (sets the limit of the project)
 - Time
 - Resources
- Timescales

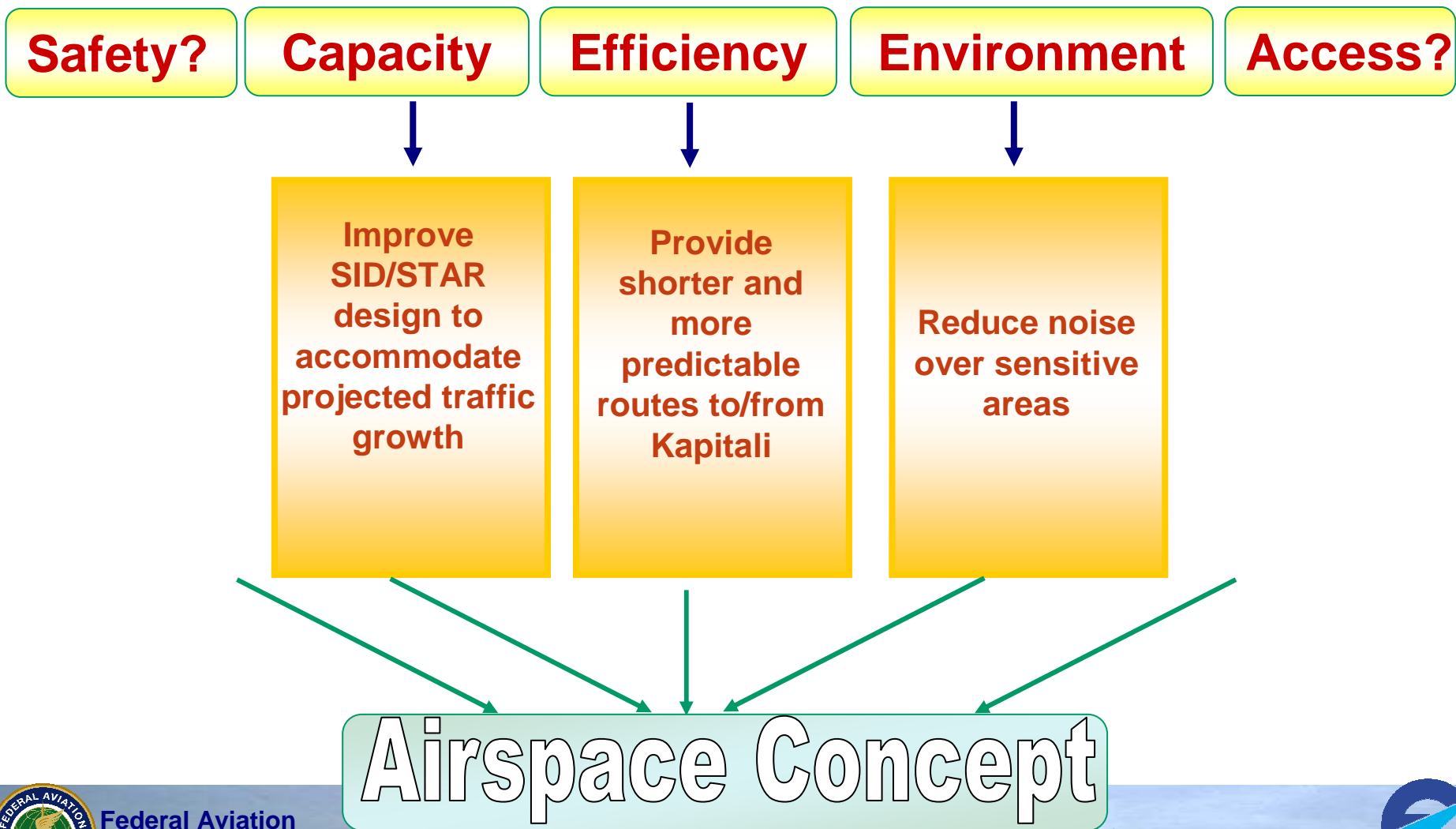
Sometimes the most difficult task





Activity 3 (P1)

3 – Project objectives



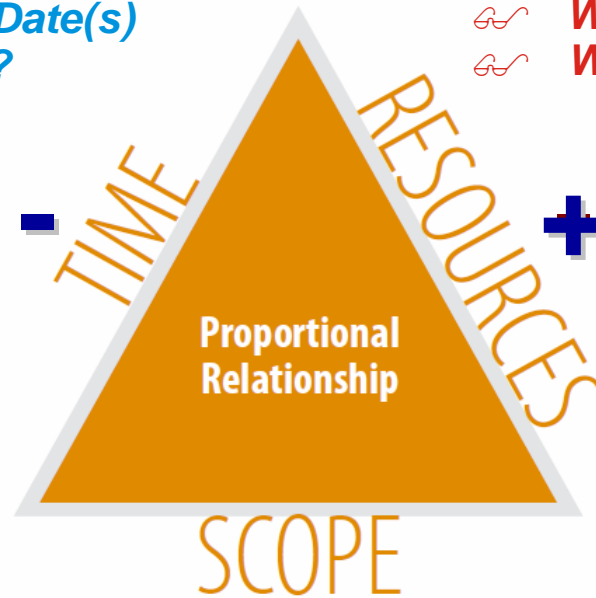


Activity 3 (P1)

3 – Project objectives, scope and timescales

Implementation Date(s)
Phases of Work?

Which Human Resources?
What about the budget?

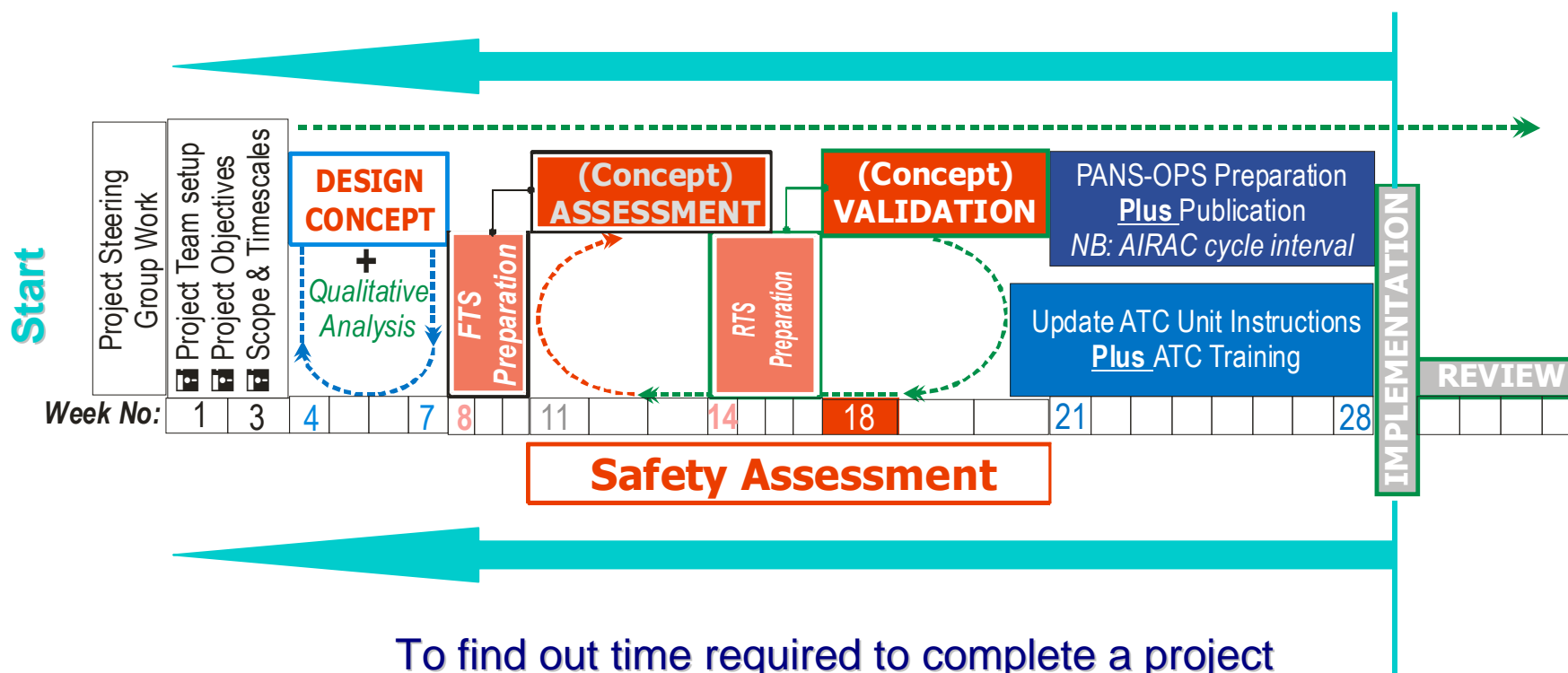


- What is the Objective ?*
- How much can be done?*
- What cannot be done?*



Activity 3 (P1)

3 – Project timescales



To find out time required to complete a project
 – calculate **backward** from Implementation date



PLANNING TOOL EXAMPLE

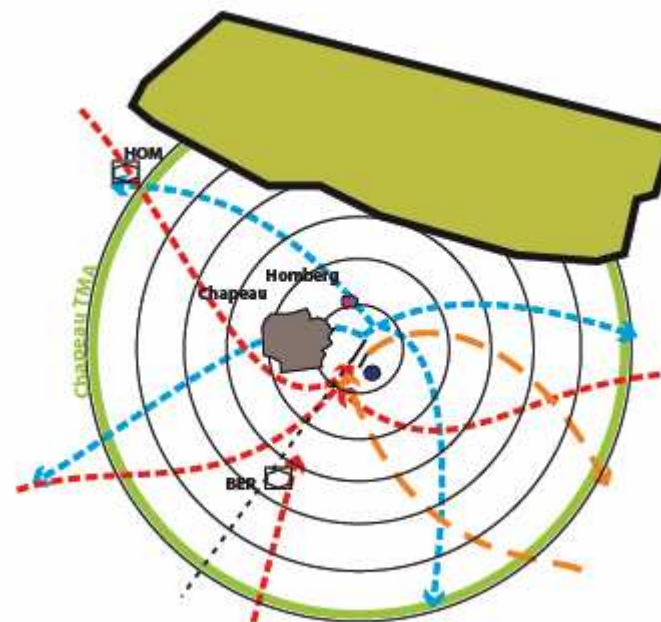
AIRSPACE CONCEPT HANDBOOK ACTIVITIES 1 TO 15: PROJECT PLANNING SAMPLE				
ACT	<i>(to be read from bottom-up)</i>	No of Days	Key Dates (latest)	
15	Implementation of Airspace Change (Match Airac Cycle date)	0	06/02/2014	<< Enter INTENDED Implementation Date here (Must match Airac Cycle Date)
14	Implementation Planning - Write up LoAs - ATC System Changes	56	12/12/2013	
	Additional working day buffer to allow for un foreseen delays	60	13/10/2013	
12+13	Procedure Design and Validation + 56 day AIRAC cycle - ATC Training †	90	15/07/2013	
11	Airspace Concept Validation by Real-Time Simulation (Preparation and Runs)	100	06/04/2013	
11	Airspace Concept Validation by Fast-Time Simulation (Preparation and runs)	70	26/01/2013	
10	Selection of ICAO Navigation Specification	2	24/01/2013	
7-9	Finalise Airspace Design - iteration	5	19/01/2013	
9	Airspace Design: Structures and Sectors	5	14/01/2013	
7	2nd Iteration: Airspace Design - Routes and Holds	5	09/01/2013	
8	Navigation Analysis of Airspace Design	5	04/01/2013	
7	1st Iteration: Airspace Design - Routes and Holds	10	25/12/2012	
6	Data collection and agreement on CNS/ATM assumptions incl. Fleet capability; traffic sample etc.	5	20/12/2012	
5	Select Safety Criteria; Determine Performance Criteria and understand Safety Policy Consi- derations	10	10/12/2012	
4	Analyse Reference Scenario (incl. Data collection of full ATM operations and critical review of current operations)	20	20/11/2012	
1-3	Agree Operational Requirement; Project Planning; Create Airspace Design Team; Agree Project Objectives and Scope	10	10/11/2012	<< This is the latest project start date
	Total number of working days required	453		
Notes				
†	Assumes availability of FTS or RTS simulator slots, available of required specialists & ATCs/pseudo pilots			
‡	Separate no of days not calculated for ATC Training; Above shows that this would occur at the same time as PANS-OPS procedure design or during 56 day final AIRAC cycle			



ACTIVITY 4 (P1)

4 – Analysis of the reference scenario

- ➔ Assessment of present operations
- ➔ Identification of positive and negative
- ➔ Benchmark
- ➔ Avoids repeats of design flaws





ACTIVITY 5 (P1)

5 – Select Performance Criteria, Safety Policy and Criteria

- Set success criteria
- Select Safety Management system
- Select Safety Assessment Methodology
- What evidence is needed to prove safety of design

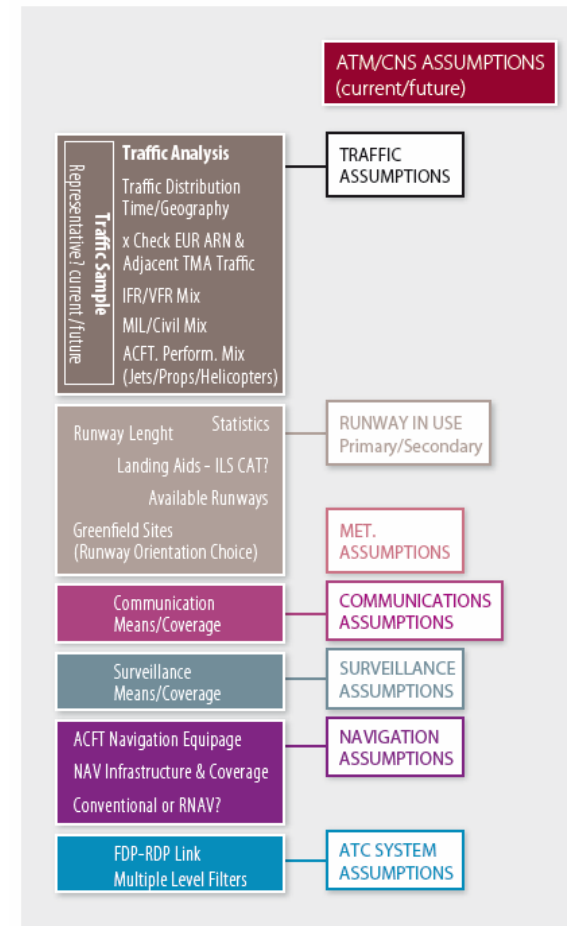




ACTIVITY 6 (P1)

6 – Agree on ATM/CNS assumptions

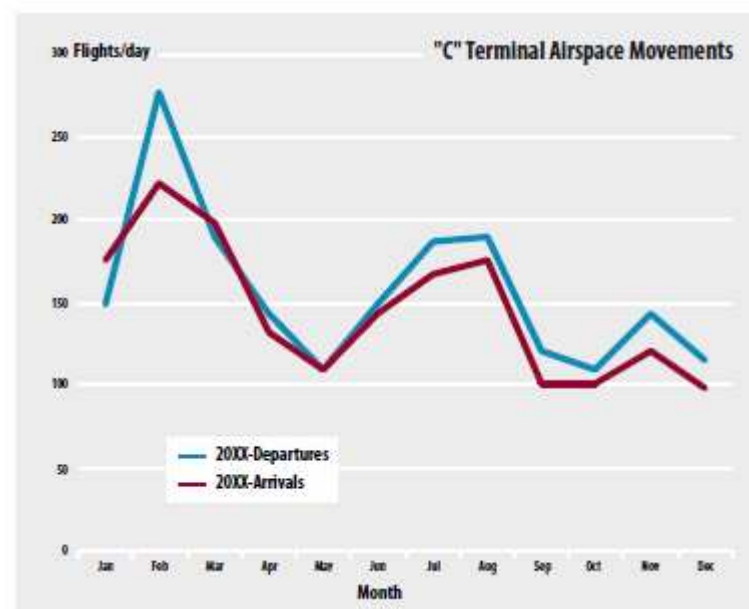
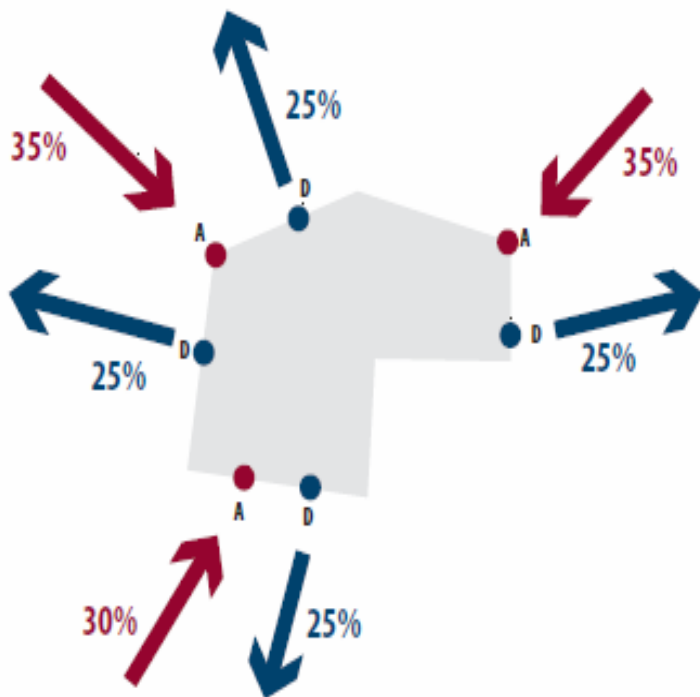
- Fleet capability
- Traffic sample (distribution & assignment)
- Rwy in use
- Met assumptions
- CNS assumptions





ACTIVITY 6 (P1)

6 – Agree on ATM/CNS assumptions



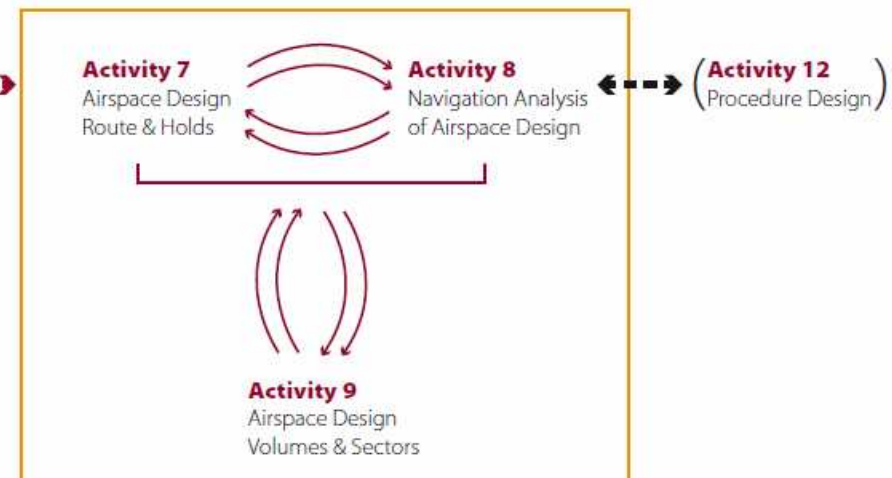


ACTIVITY 7 (P1)

7 – Design the Airspace

- 1st Design Routes
- 2nd Undertake a Navigation Analysis of the route design
- 3rd Define the airspace volumes and sectorise these, if needed

Activity 6
Agree CNS/ATM Assumptions



Iterations necessary

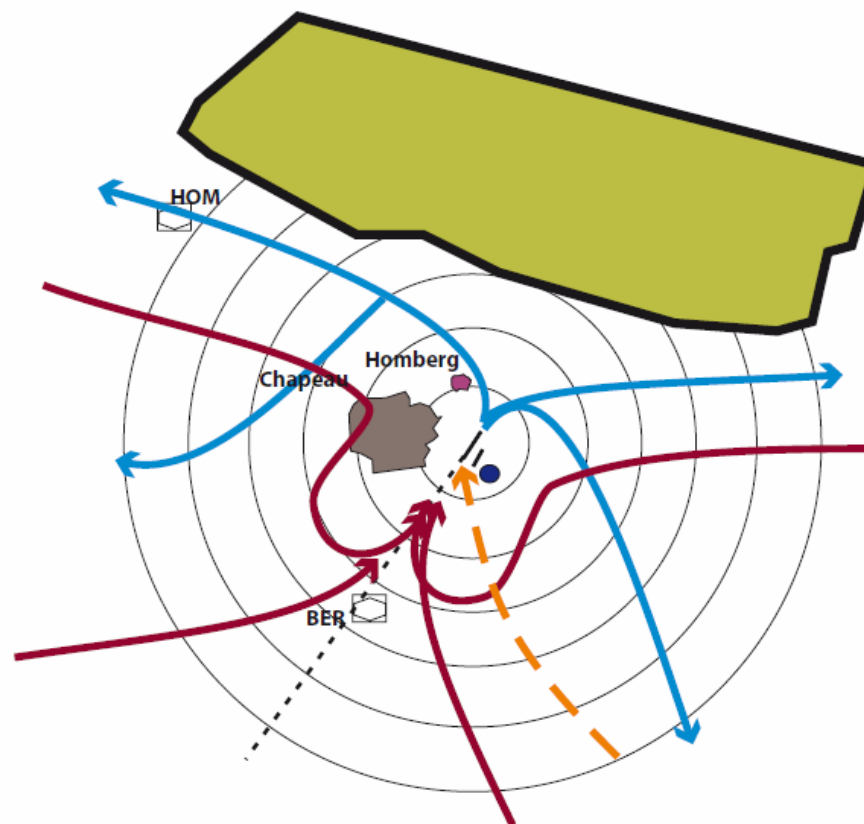


ACTIVITY 7 (P1)

7 – Design the Airspace

- Arrivals
- Departures
- Transit
- VFR
- Military

NEVER try and fit the routes into the existing airspace volumes





ACTIVITY 8 (P1)

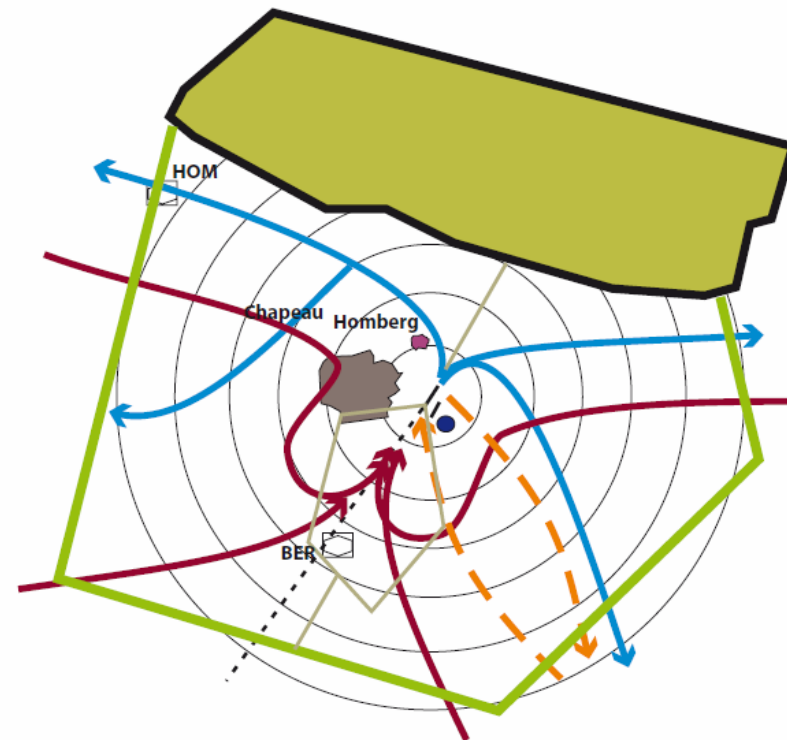
8 – Navigation analysis of Airspace design

- What capability is needed?
- Fleet capability
- Available Navaid infrastructure?



9 Design Airspace Volumes and Sectors

- Sectorisation
- Airspace volume
- Iterations possible





ACTIVITY 10 (P2)

10 – Select ICAO Navigation specification

- Review NAV specs
- Identify appropriate spec
- Go to planning and Implementation
- If no appropriate spec
 - Apply Trade off



ACTIVITY 11 (P3)

11 – Airspace Concept Validation

- Prove ATM operability & validity
- Assess objectives
- Identify possible weak points
- Provide evidence and proof to support Safety Assessment





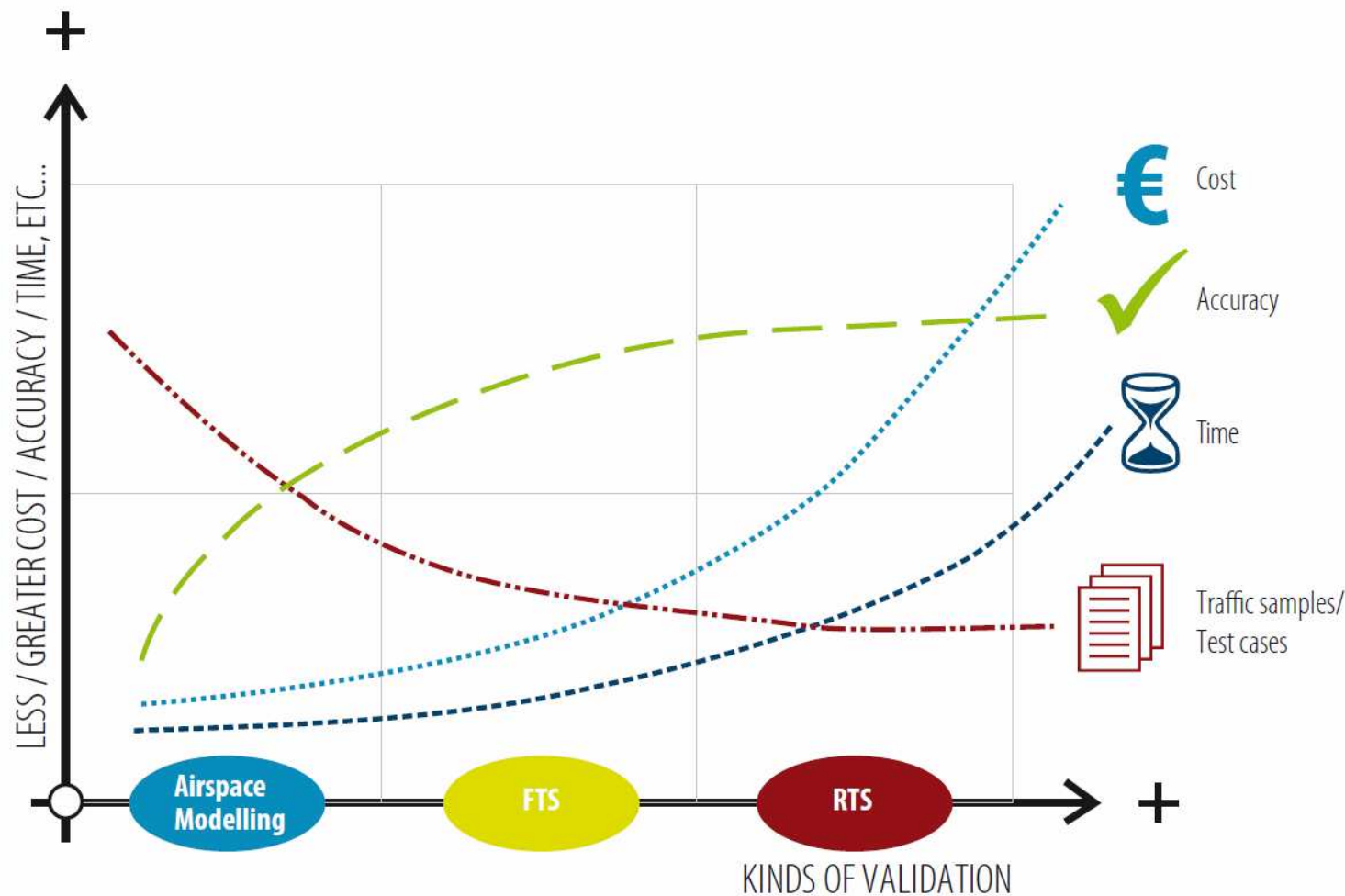
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Airspace Concept Validation





CONCEPT VALIDATION





ACTIVITY 12 (P3)

12- Procedure design

- Design according to Doc 8168
- Procedure ground validation
 - Obstacle
 - Data
 - Infrastructure
 - Fly ability
 - Evaluate
- Flight inspection
- ATC system considerations
- Awareness and Training material





ACTIVITY 13 (P3)

13- Procedure validation

- Obstacle clearance
- Data
- Infra structure
- Fly ability
- Charting
- Flight inspection



4

Implementation

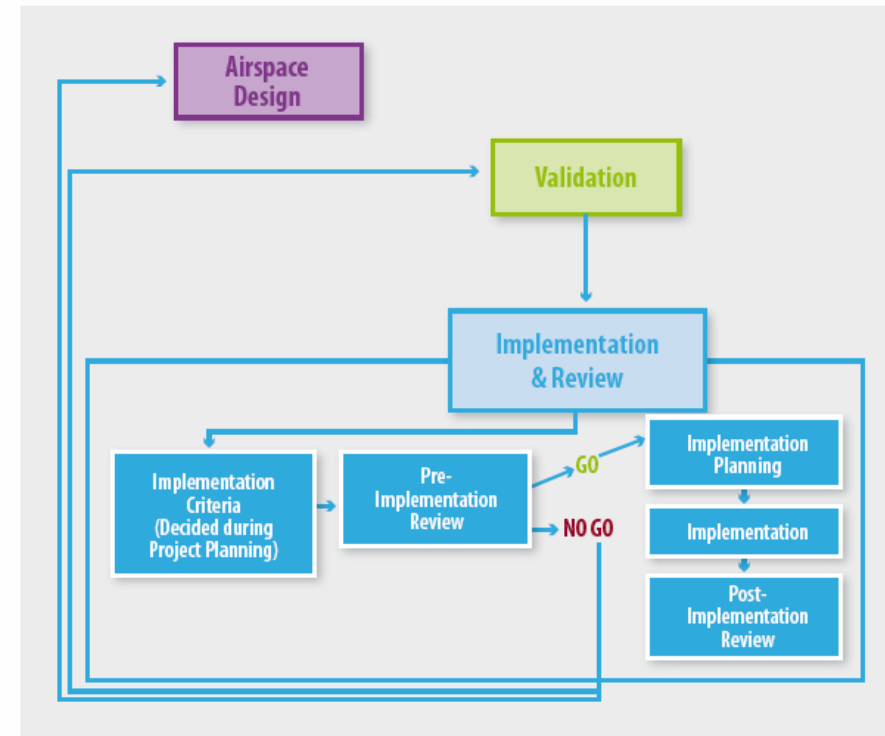


ACTIVITY 14 (P3)

14- Implementation planning

✈️ Pre-implementation review

- Keep design team available
- Monitor process





ACTIVITY 14 (P3)

15 - Implementation

- Monitor process
- Support OPS
 - Redundancy or contingency procedures
- Support controllers and pilots
- Keep LOG system Post implementation review
 - Assess if objectives are met
 - Measure!



5

Lessons Learned



RNAV 5 implementation in EUR en route airspace

35

- Selecting the right Nav Spec can be very difficult ... more older aircraft than you think!
- Roll out airspace changes over time: never at the same time as the PBN switch on date
- NEVER 'switch on' PBN in continental en route without 'switching it on' in the Terminal Airspace as well...
- Aircraft populations do not make 'cleaner' turns because of PBN ... for that you need RF/FRT





P-RNAV implementation in EUR terminal airspace

- ✈ Implementation without a mandate is counter productive and caused a log jam.
 - Without the mandate, aircraft did not equip
 - Because aircraft not equipped, ANSPs reluctant to provide procedures
 - A bit like walking on glue..
- ✈ Without a mandate, many P-RNAV capable aircraft had no P-RNAV approval but wanted to fly the procedures anyway.
- ✈ In some cases, a great number of SIDs/STARs were designed at one airport which caused severe shortage of data base storage space.





RNAV 1 and 2 implementation in US

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- Co-ordination with stakeholders is a pre-requisite for success
- Controllers had unrealistic expectations of aircraft turn performance
- Education needed on RNAV and RNP



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Airspace Concept Workshops for PBN Implementation





Mixed Navigation Performance

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- Avoid if possible
 - Increases workload
 - Flight planning implications
- ATC prefers uniform applications (no mix)



THANK YOU

