

EURONONTROL Agency Research Team
Workshop “Validation/Measuring ATM Performance”

Validation Chain for ATM Concepts

Michael Roeder, May 2015, Bretigny



Knowledge for Tomorrow



Validation chain for ATM Concepts (example A-SMGCS projects)

1st) Challenge / problem identification

2nd) Opportunities / Solutions

3rd) Concept definition

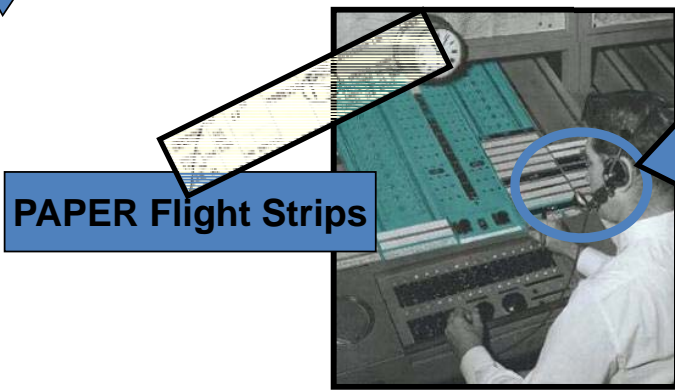
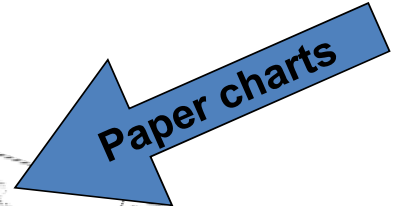
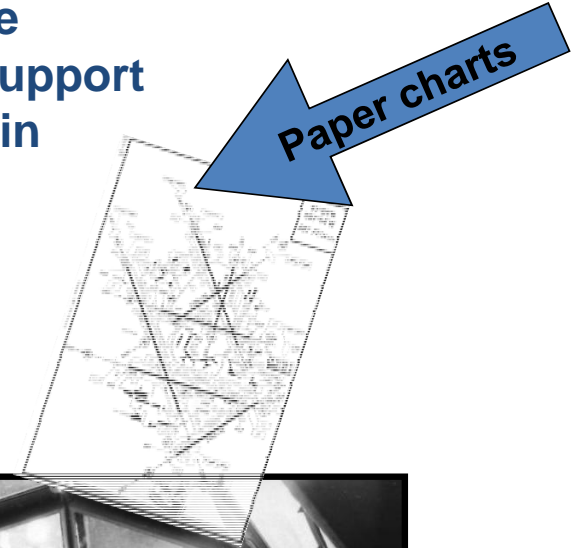
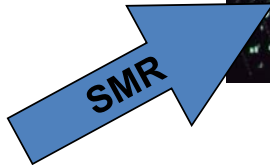
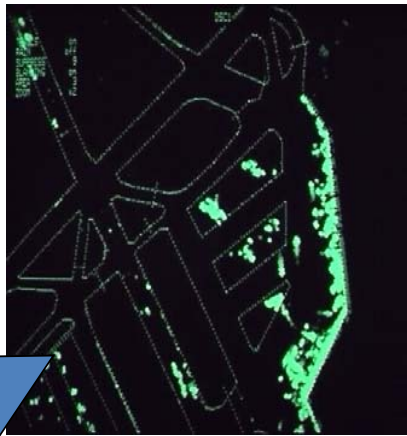
4th) Implementation

5th) **Verification / Validation**



1st) Challenge / Problem Identification

Before introducing of A-SMGCS the controllers and pilots got neither support under low visibility conditions nor in planning and guidance to increase safety and airport throughput.



PAPER Flight Strips



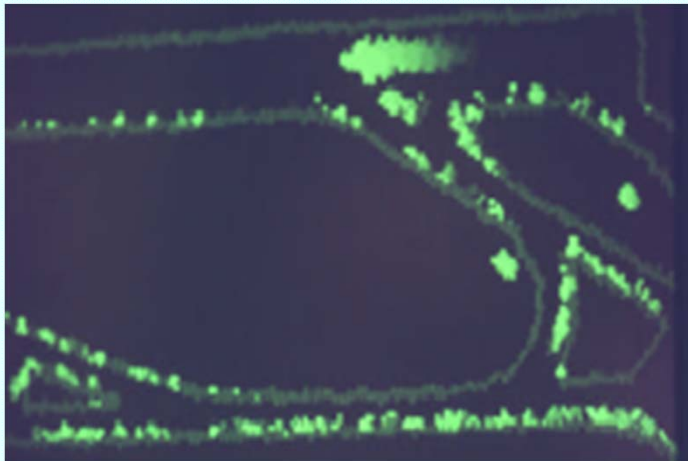
>ECTL ART WS > M.Roeder • Validation Chain > May 2015, Brittany



2nd) Opportunities / Solutions

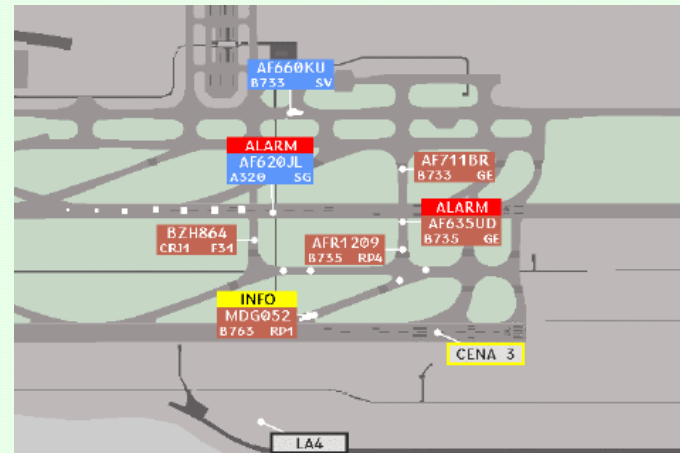
Airport operations:

- ground bottle-neck
- weather dependant



Problem solution:

Advanced **S**urface **M**ovement **G**uidance and **C**ontrol **S**ystem
(A-SMGCS)



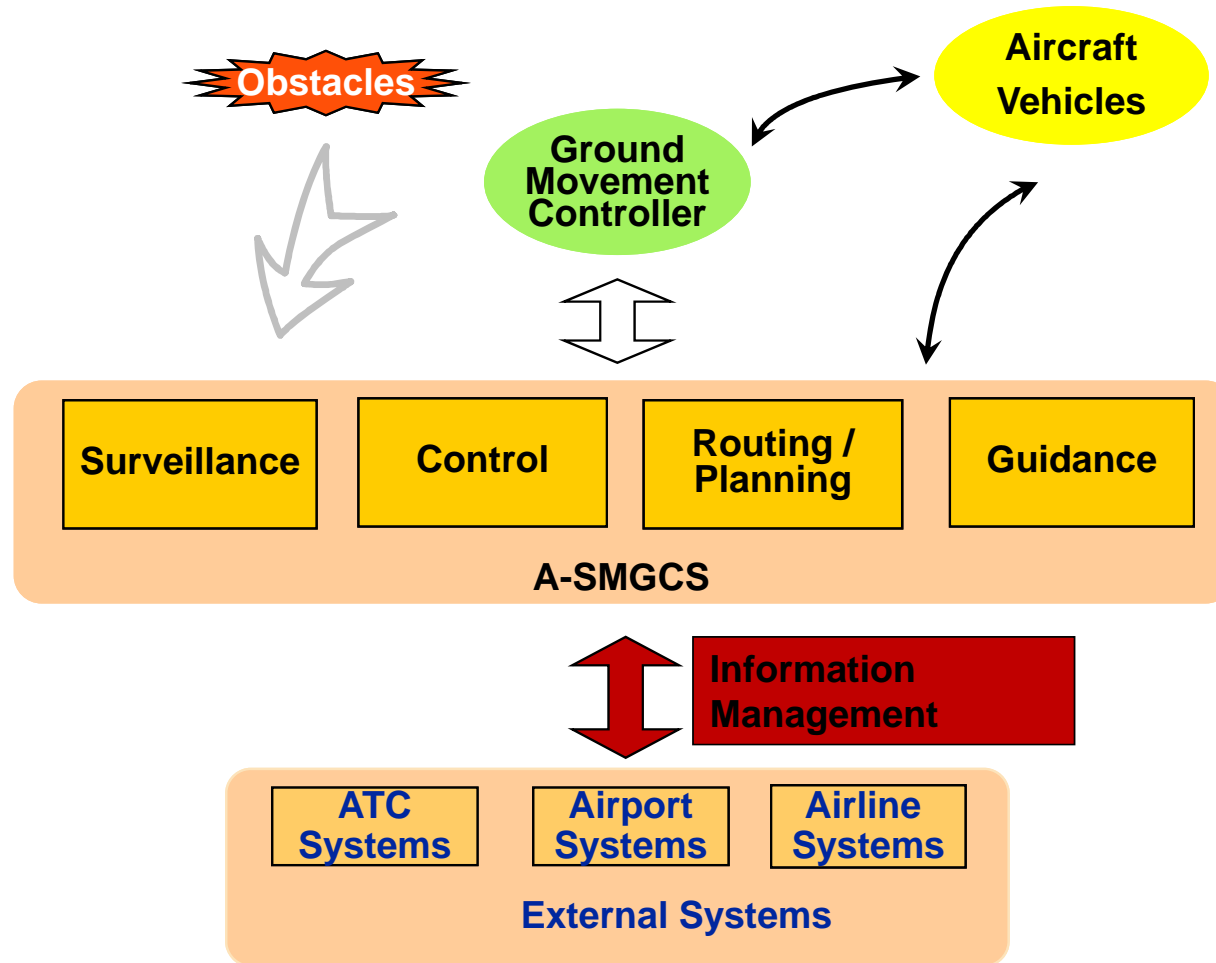
3rd) Formal Requirement for the Concept Definition

*“An **Advanced Surface Movement Guidance and Control System (ASMGCS)** is expected to provide adequate capacity and safety in relation to the specific weather conditions, traffic density and aerodrome layout by use of modern technologies and a high level of integration between the various functionality.”¹*

1: ICAO Manual of Advanced Surface Movement Guidance and Control Systems, Doc 9830 AN/452, 2004

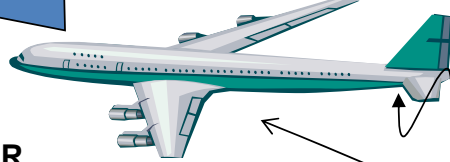


4th) Concept Implementation



Services & Functions implemented in EMMA

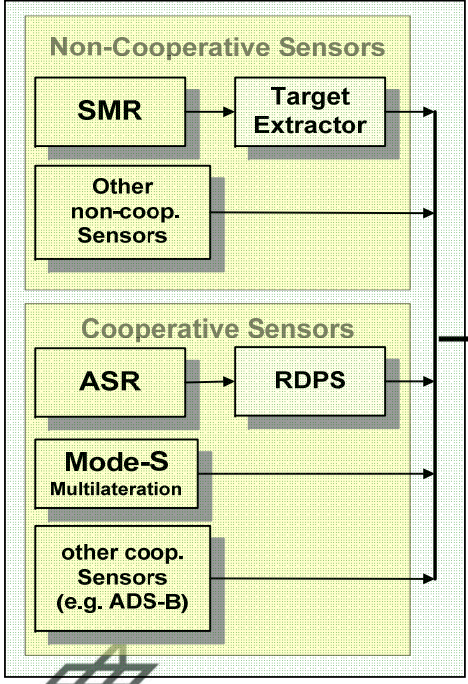
EMM, GTD
TCD, SMA, HUD



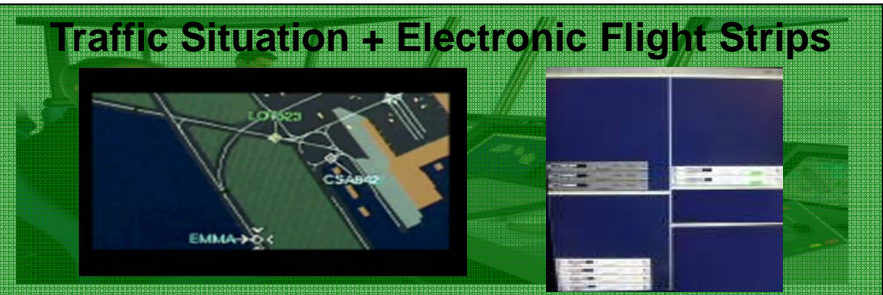
TAXI-CPDLC



Mode A/C/S SSR
ADS-B 1090ES

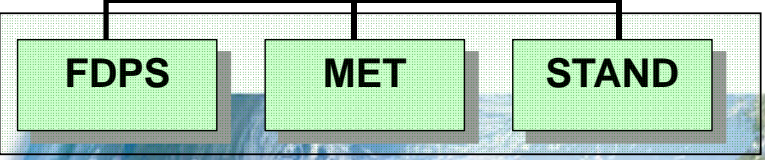
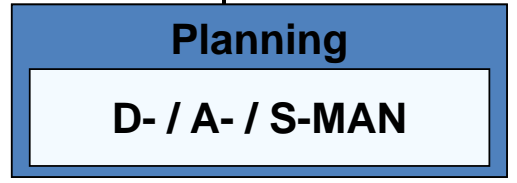
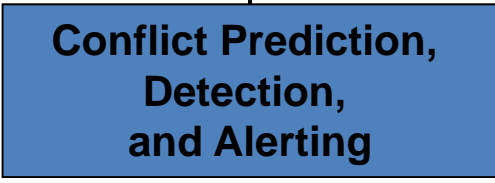


TIS-B

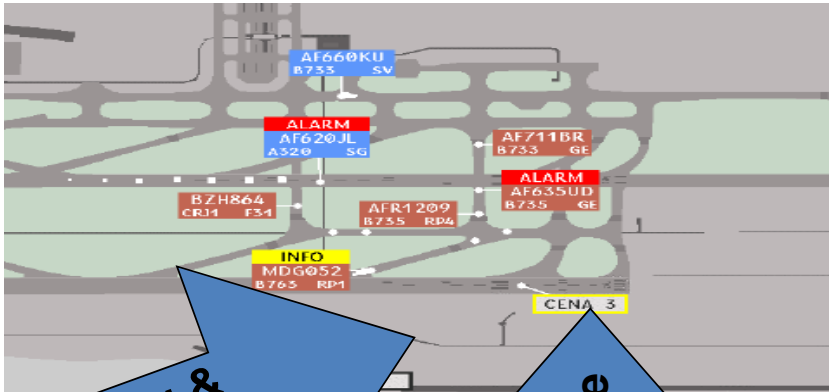


TIS-B Ground Station

LAN



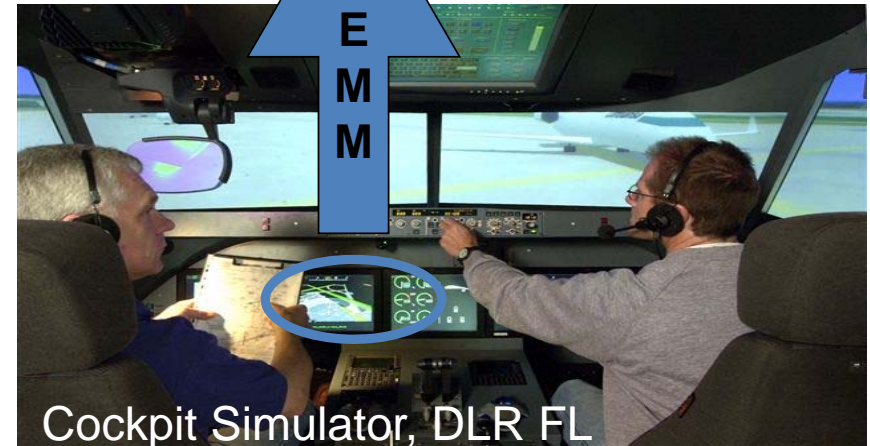
A-SMGCS Level I&II



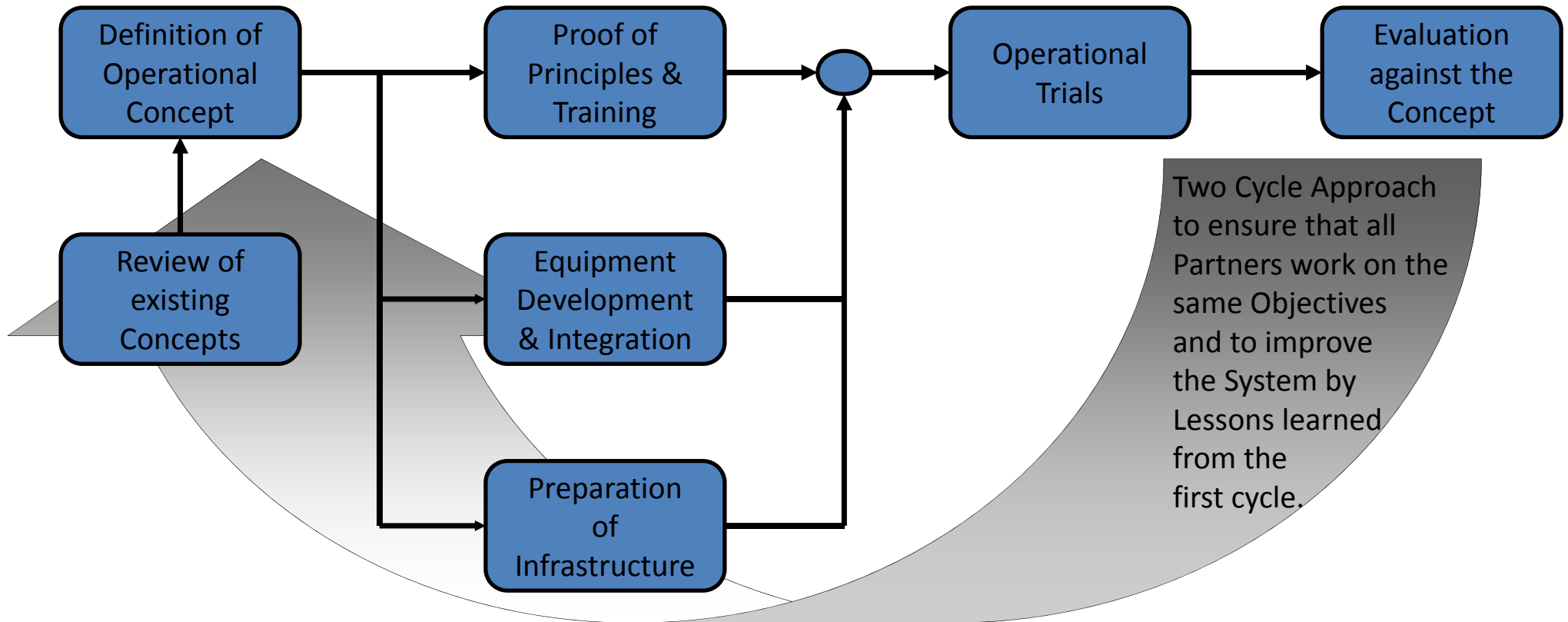
Monitoring & Alerting

Surveillance

EMM



5th) Iterative Approach



What is Validation



Yes, it certainly works technically – you may have built the system right, but it's not the right system for me

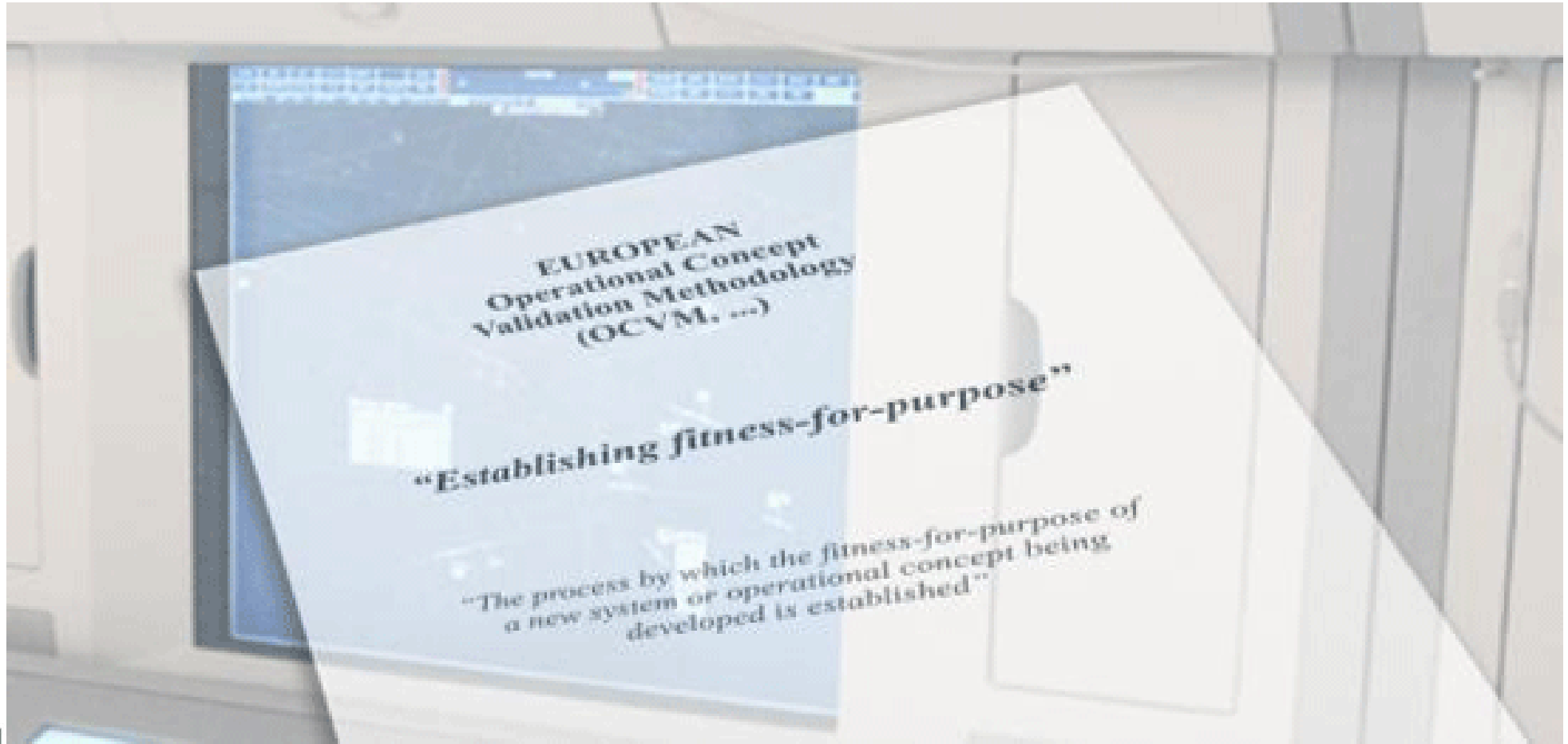
Technical feasible?

Users' requirements fulfilled?
... is the new concept acceptable?

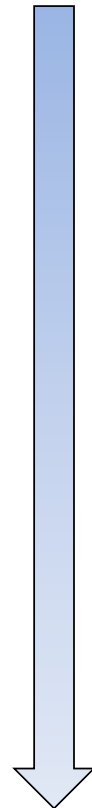
Where are the benefits?
... less workload?
... more throughput?



E-OCVM



Validation Test Plan (EMMA example)

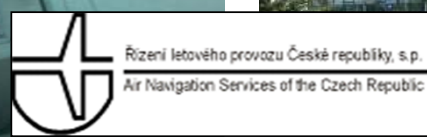




Step	Activity	Description	2-D6.1.1a & b sections
<i>Step 0 "State Concept and Assumptions"</i>	0.1	Understand the problem	Section 4.1, 2-D6.1.1a
	0.2	Understand the proposed solution(s)	Section 4.2, 2-D6.1.1a
<i>Step 1 "Set Validation Strategy"</i>	1.1	Identify the stakeholders, their needs, and involvement	Section 5.1, 2-D6.1.1a
	1.2	Identify the existing information, including current and target levels of maturity	Section 5.2, 2-D6.1.1a
	1.3	Describe validation expectations and outline cases – outcomes, products, what will success look like	Section 5.3, 2-D6.1.1a
	1.4	Identify programme validation objectives in key performance areas	Section 5.4, 2-D6.1.1a
	1.5	Establish initial validation requirements, and draft validation strategy	Section 5.5, 2-D6.1.1a
	1.6	Select validation tools or techniques	Section 5.5, 2-D6.1.1a
	1.7	Define validation strategy	Section 5.6, 2-D6.1.1a
<i>Step 2 "Determine the Experimental Needs"</i>	2.1	Identify stakeholders' acceptance criteria and performance requirements	Guidance for specific validation test plans in: Section 3.1, 2-D6.1.1b
	2.2	Identify project and exercise validation objectives	Section 3.2, 2-D6.1.1b
	2.3	Refine validation strategy	Section 3.3, 2-D6.1.1b
	2.4	Identify indicators and metrics	Section 3.4, 2-D6.1.1b
	2.5	Specify validation scenarios	Section 3.5, 2-D6.1.1b
	2.6	Produce validation exercise plan	Section 3.6, 2-D6.1.1b Section 3.7, 2-D6.1.1b Section 3.8, 2-D6.1.1b
	2.7	Prepare the platform or facility	Section 3.9, 2-D6.1.1b
	2.8	Conduct pre-exercise testing and training	Section 3.10, 2-D6.1.1b
<i>Step 3 "Conduct the Experiment"</i>	3.1	Conduct validation experiment	Section 4, 2-D6.1.1b
	3.2	Assess for unexpected effects or behaviours	Section 4, 2-D6.1.1b
<i>Step 4 "Determine the Results"</i>	4.1	Perform analysis specified in the analysis plan	Guidance for validation reports in: Section 5.1, 2-D6.1.1b
	4.2	Prepare analysis contributions	Section 5.2, 2-D6.1.1b
	4.3	Prepare validation report	Section 5.2, 2-D6.1.1b
<i>Step 5 "Information for Dissemination to Stakeholders"</i>	5.1	Disseminate information to stakeholders and decision makers	Section 6.1, 2-D6.1.1b
	5.2	Draw conclusions and decide on actions feedback to validation strategy	Section 6.2, 2-D6.1.1b



Stepwise Approach - PRG Validation Trials of EMMA

EFS + DMAN
RP + TAXI-CPDLC



During EMMA more than 40 test runs with 55 movements (á 60 min. duration) with 7 ATCOs and 11 airline pilots were performed.

GTD + TAXI-CPDLC



RTS1

RTS2a

RTS2b

OST

November 2007

June 2008

October 2008

November 2008



Main Deliverables (EMMA example)

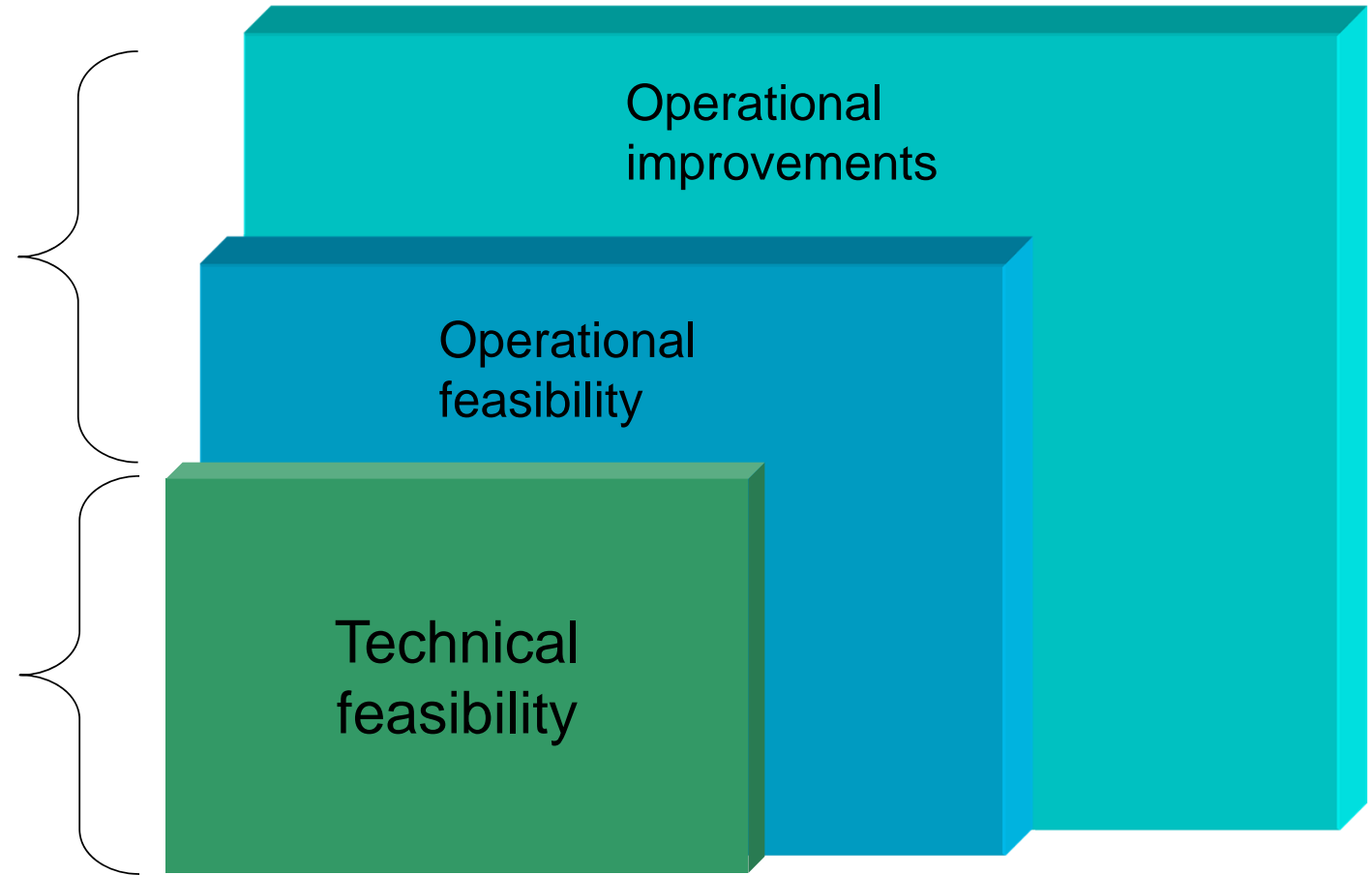
- 2-D111 Systems, Procedures and Op. Requirements (SPOR)
- 2-D611a&b Generic Validation Test Plan
- 2-D612 Specific Validation Test Plans
- 2-D616 for CDG, PRG, TLS, MXP, Airborne
- 2-D631 Test Reports
- 2-D661b for CDG, PRG, TLS, MXP, Airborne
- 2-D671 Validation Comparative Analysis Report
- 2-D672 Validation Recommendations Report



Verification & Validation

Validation:
Did we build
the right system?

Verification:
Did we build
the system right?



Validation Chain

Operational feasibility of

- Modification of input devices
- Route generation
- Datalink device

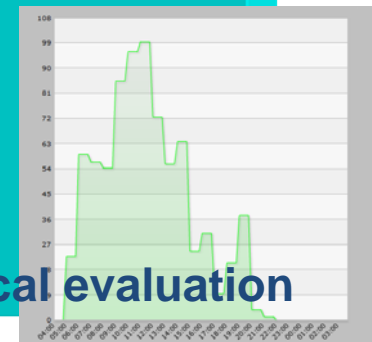
Operational improvements

- Safety
- Throughput
- Efficiency
- Human Factors (SA, WL)
- Environmental Issues

Users questionnaires during debriefing after the trials

ID	General							EMMA2 OR
		1	2	3	4	5	6	
	The A-SMGCS is able to integrate new movements and thus provides complete situational information.	①	②	③	④	⑤	⑥	GEN_Serv-04
	When working with the A-SMGCS responsibilities and functions do vary but are clearly defined.	①	②	③	④	⑤	⑥	GEN_Serv-06
	I think the A-SMGCS was well integrated into the existing systems.	①	②	③	④	⑤	⑥	GEN_Serv-10

Strongly disagree
Disagree
Slightly disagree
Slightly agree
Agree
Strongly agree



Statistical evaluation



Tailor-made questionnaires and debriefing preferred



204 op. Requ.
from EMMA2
Concept

ATCO Questionnaire

ID	General	EMMA2 OR
	The A-SMGCS is able to integrate new movements and thus provides complete situational information.	GEN_Serv-04
	When working with the A-SMGCS responsibilities and functions do vary but are clearly defined.	GEN_Serv-06
	I think the A-SMGCS was well integrated into the existing systems.	GEN_Serv-10

Pilot Questionnaire

ID	General	EMMA2 OR
	The A-SMGCS is able to integrate new movements and thus provides complete situational information.	GEN_Serv-04
	When working with the A-SMGCS responsibilities and functions do vary but are clearly defined.	GEN_Serv-06
	I think the A-SMGCS was well integrated into the existing systems.	GEN_Serv-10

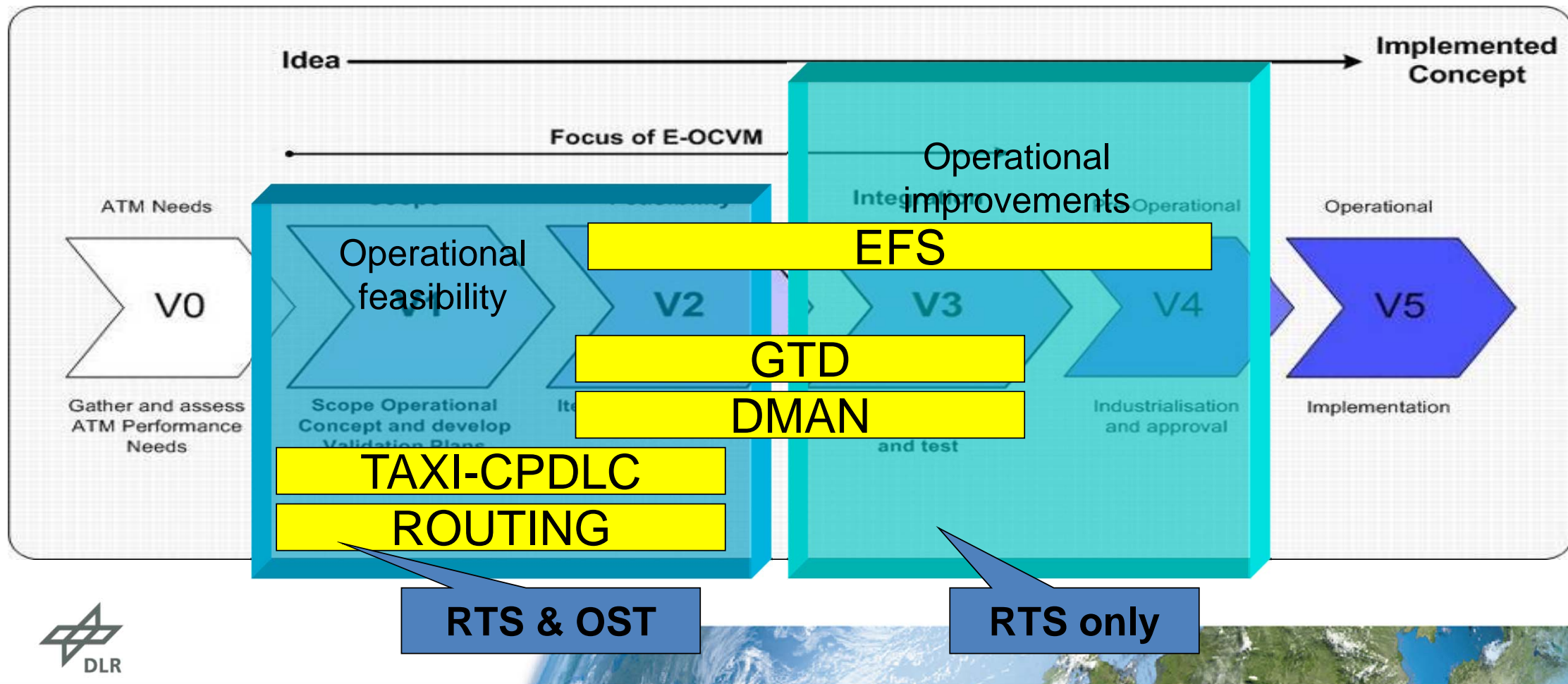
Technically Checked

ID	General	EMMA2 OR
	The A-SMGCS is able to integrate new movements and thus provides complete situational information.	GEN_Serv-04
	When working with the A-SMGCS responsibilities and functions do vary but are clearly defined.	GEN_Serv-06
	I think the A-SMGCS was well integrated into the existing systems.	GEN_Serv-10

EMMA2 Checklist with feedback to 204 op. Requ.

Condition's	visibility conditions are reduced to below AVOL, an A-SMGCS should provide for a reduction of surface movements of aircraft and vehicles to a level acceptable for the new situation.	Mean	2. In certified by operational use of A-SMGCS.
GEN_Serv-04 or Information	The system should integrate movements to provide complete situational information to all users.	✓	✓
	and to provide conflict prediction and resolution for aircraft and vehicle movement.	✓	✓

Marriage of E-OCVM Levels of Maturity & EMMA Validation Chain



Differences & Advantages of RTS and OST

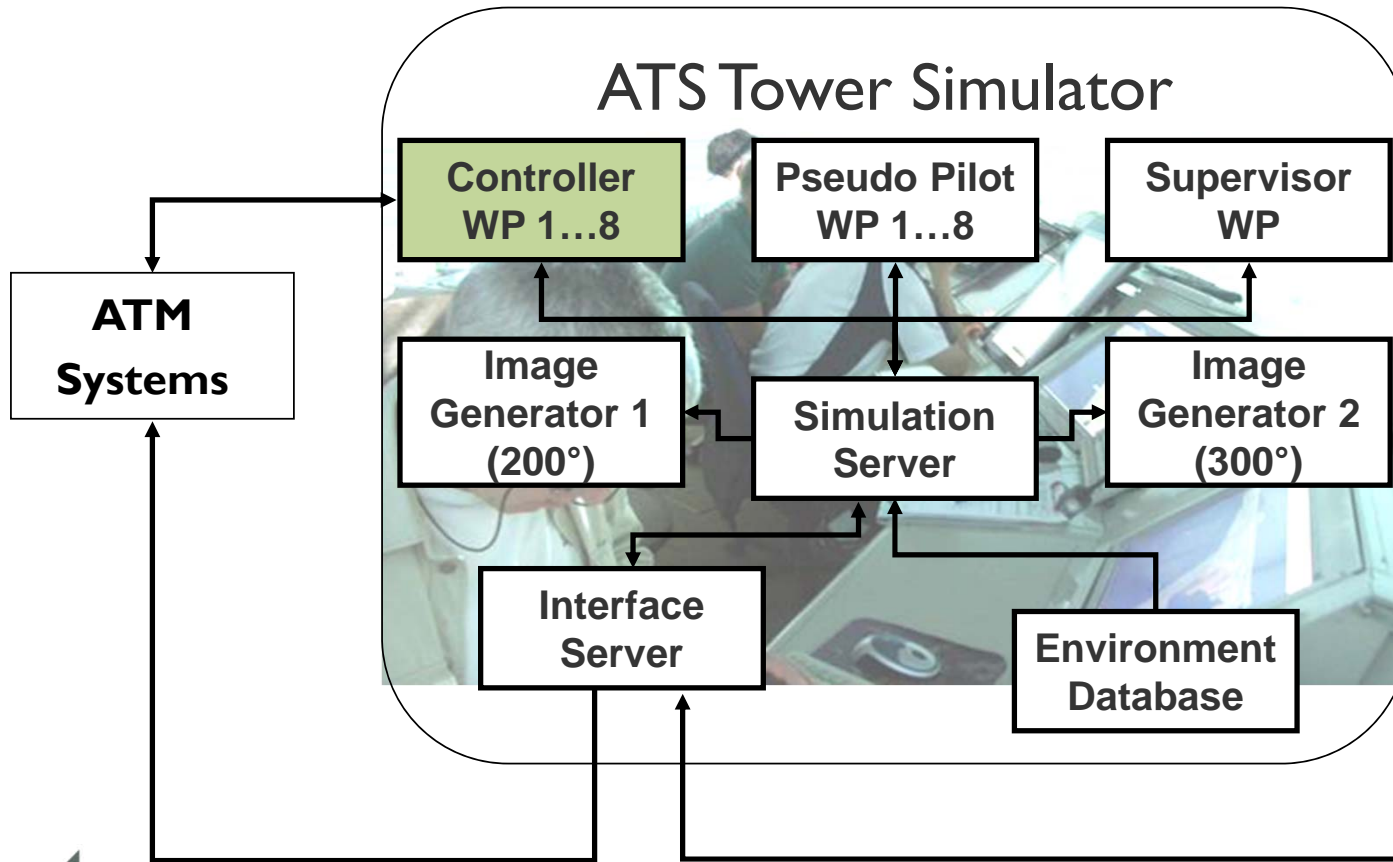
After assuring an adequate performance in the verification phase of the ATM system, validation completes the cycle by including the user's judgement about the right operation of the system.

Although many tests can be performed by field tests, some essential benefit criteria can only be validated by simulation runs. For example new defined procedures can only be tested in simulation due to safety aspects (e.g. low visibility operations, 'forced incursions' scenarios, 'forced misunderstandings' scenarios). To summaries these three different evaluation methods:

1. **Real time simulations:** Active controllers are operating with new systems / procedures in simulation
2. **Shadow mode trials:** Passive controllers are observing new systems / procedures on site without interaction with the real traffic
3. **Real operational field trials:** Active controllers are operating with the new systems / procedures on site, managing the real traffic



Use of distributed simulation facilities



General Simulator Setup and Configuration at DLR



Make use of distributed simulation facilities

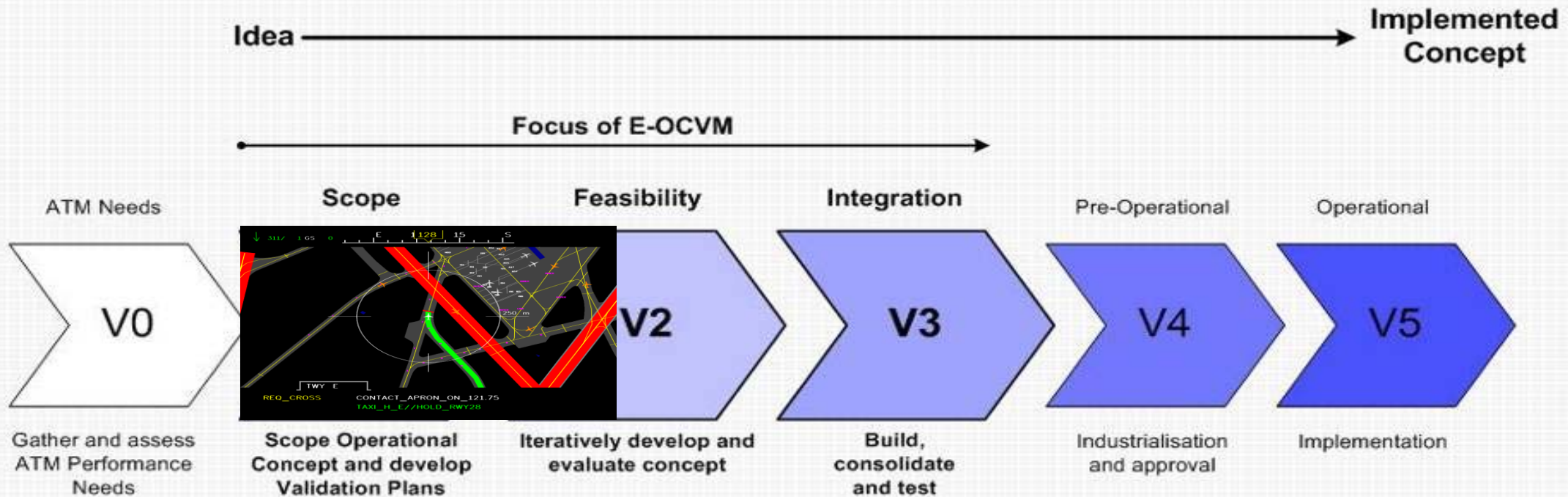
Distributed Simulation Setups (*here: ATCO-Pilot*) covers

- **Dynamic interaction** and **dependencies** between pilot and controller (→ time critical effects).
- **Interrelationship** between
 - operations at flight deck and ATC
 - visual perception and HMI interaction
 - voice- and data communication,
 - reaction time and situational awareness**at the same time onboard and at ground.**

... and facilitates the dialogue between ATCOs, pilots and developers!



Reaching HIGHER Levels of maturity



According to “European Operational Concept Validation Methodology”





Thank you for your attention!

Questions?

