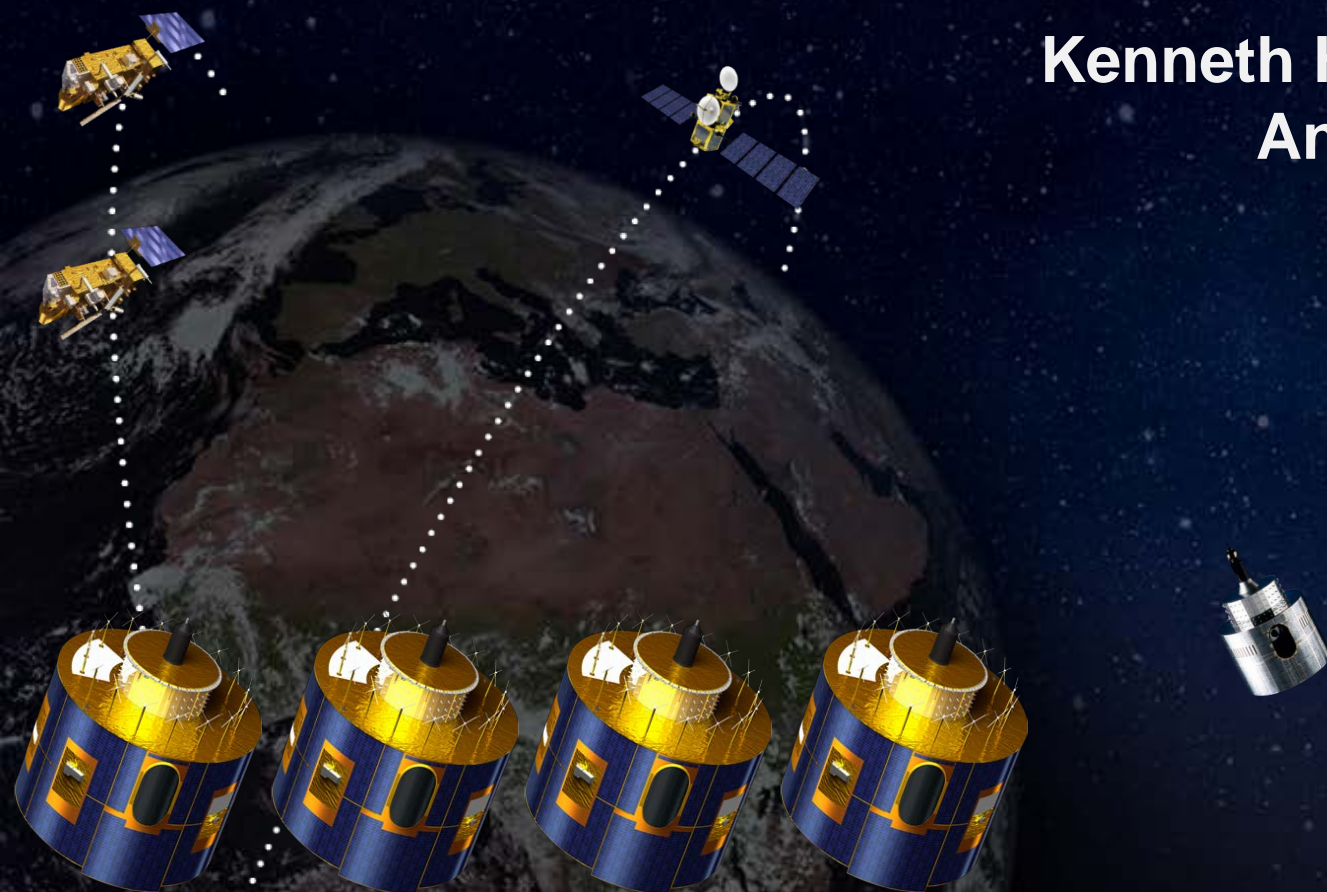


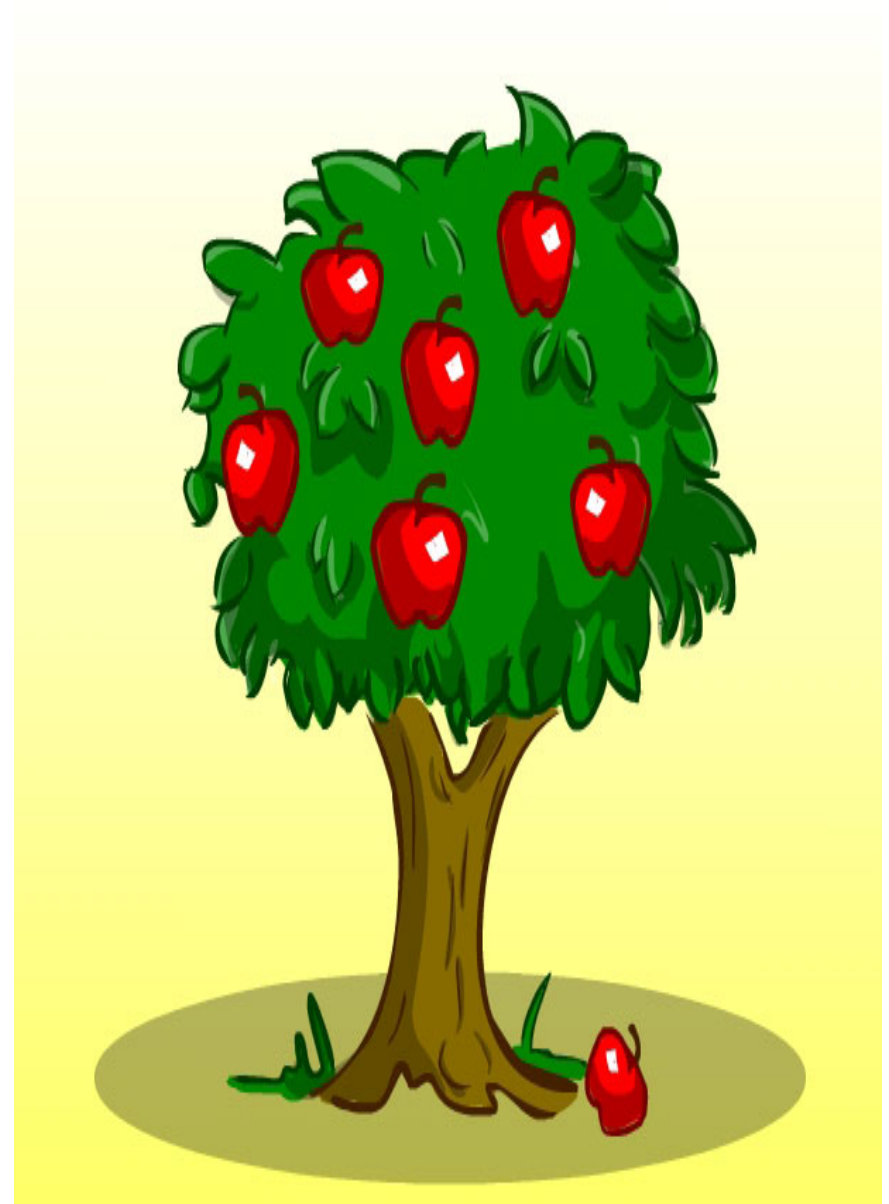
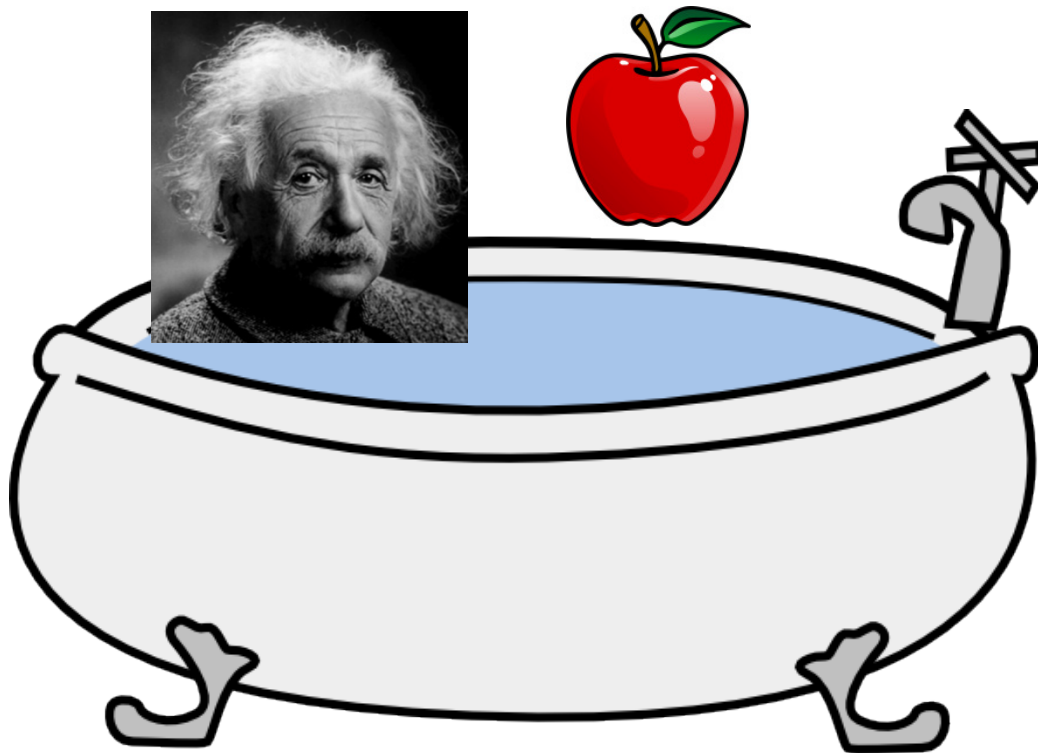
EUMETSAT FROM SCIENCE TO OPERATIONS



**Kenneth Holmlund, Sean Burns
And Beatriz Mora
EUMETSAT**



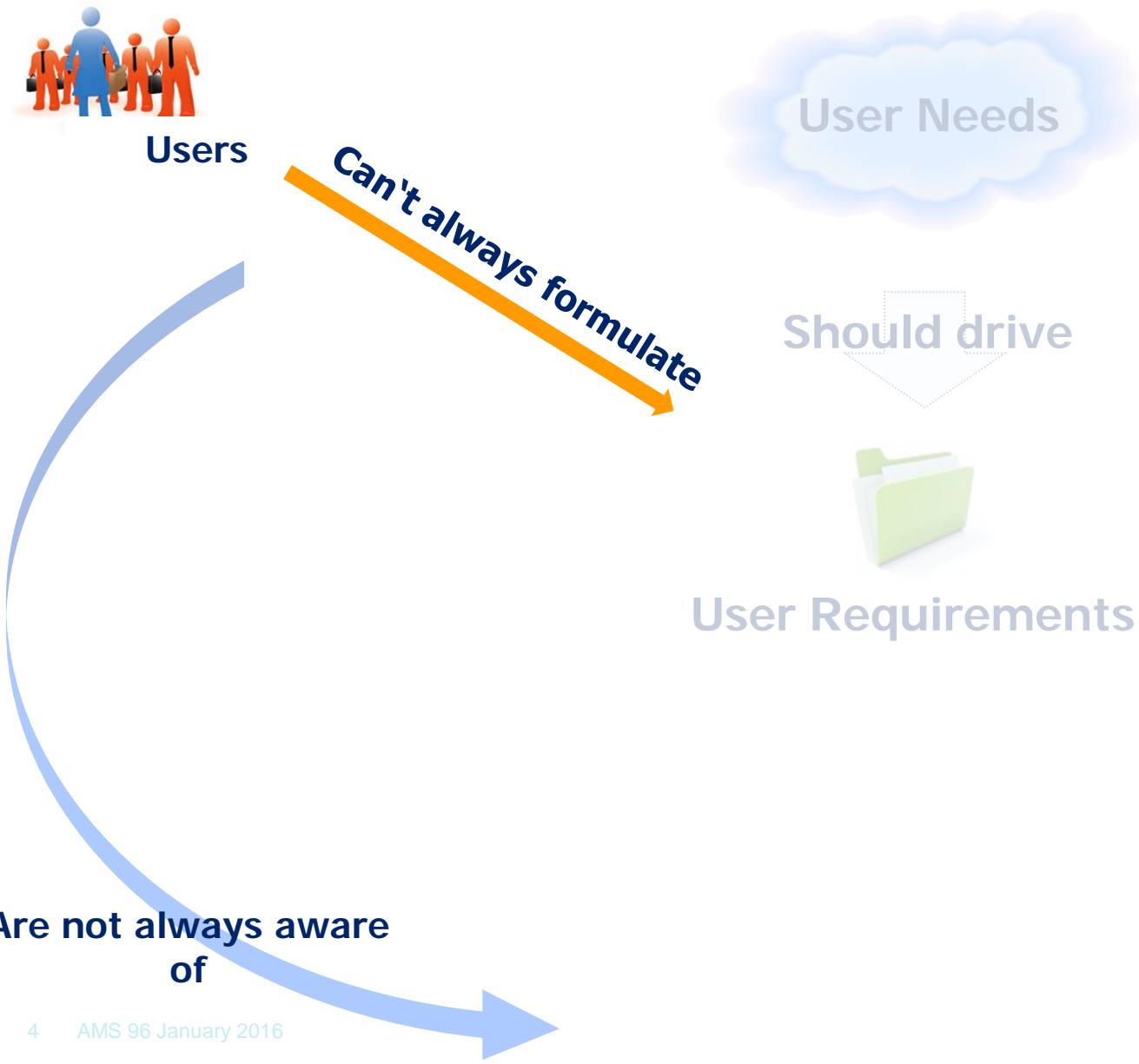
Process for having a scientific idea?



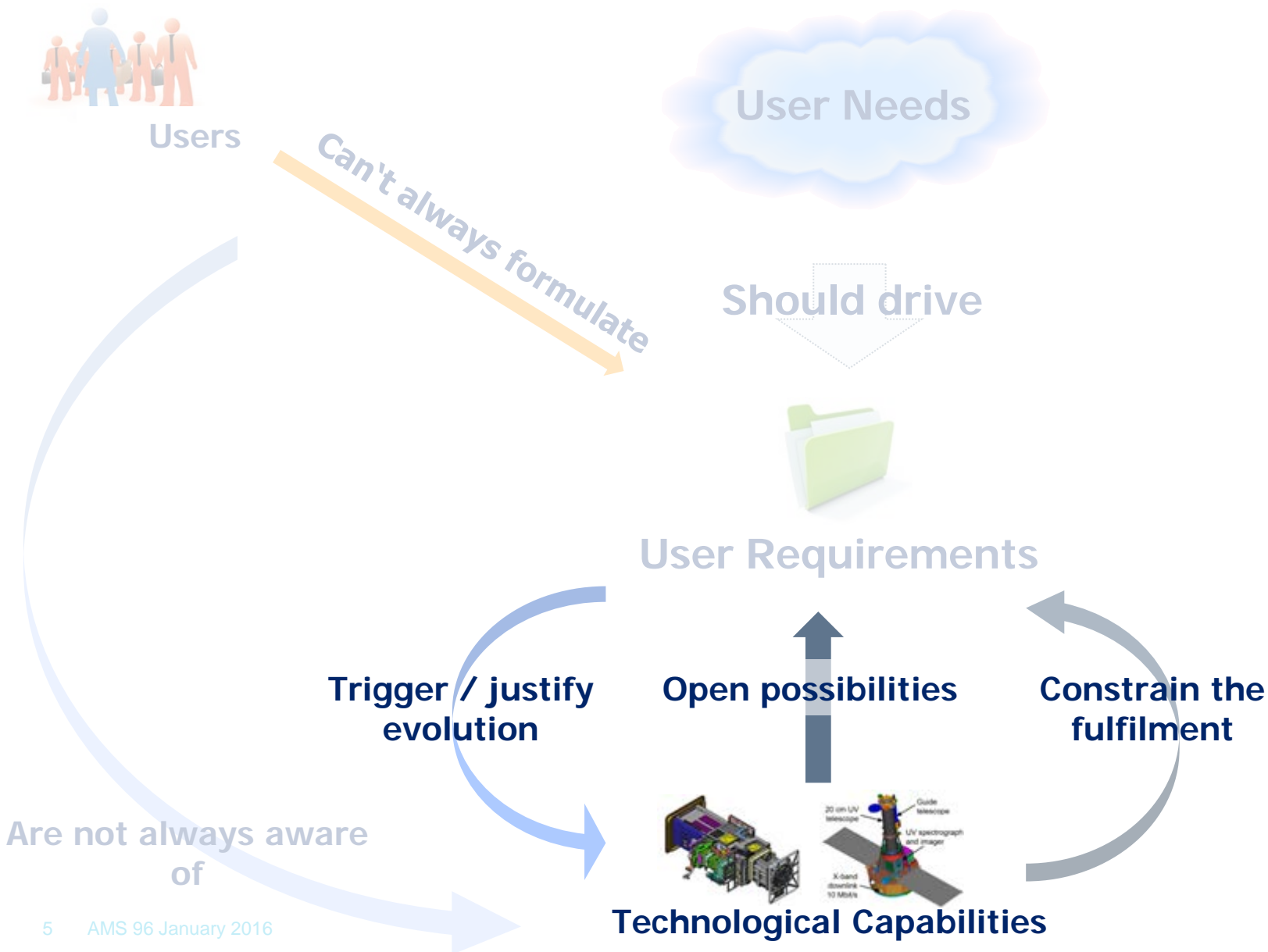
Process for user requirements elaboration



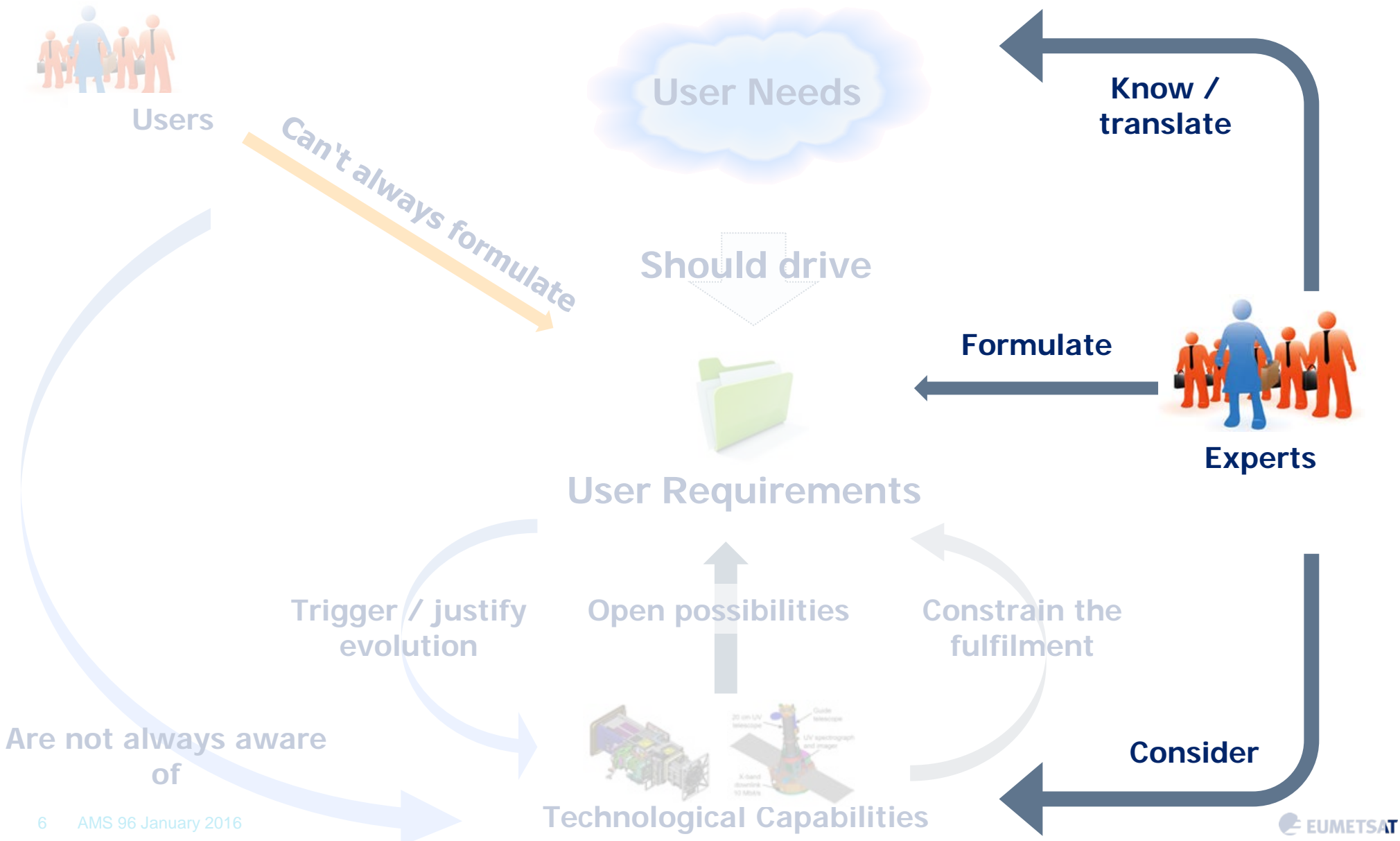
Process for user requirements elaboration



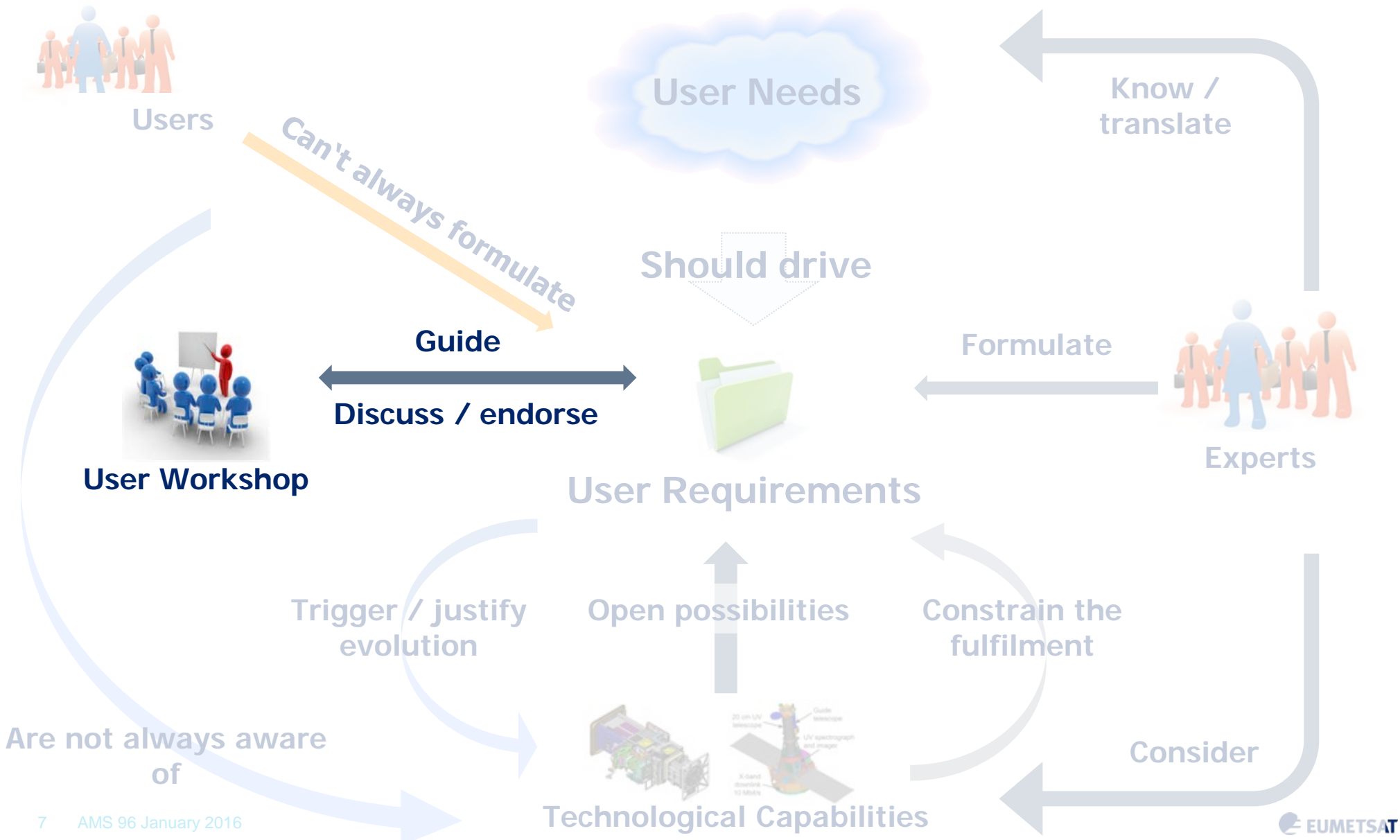
Process for user requirements elaboration



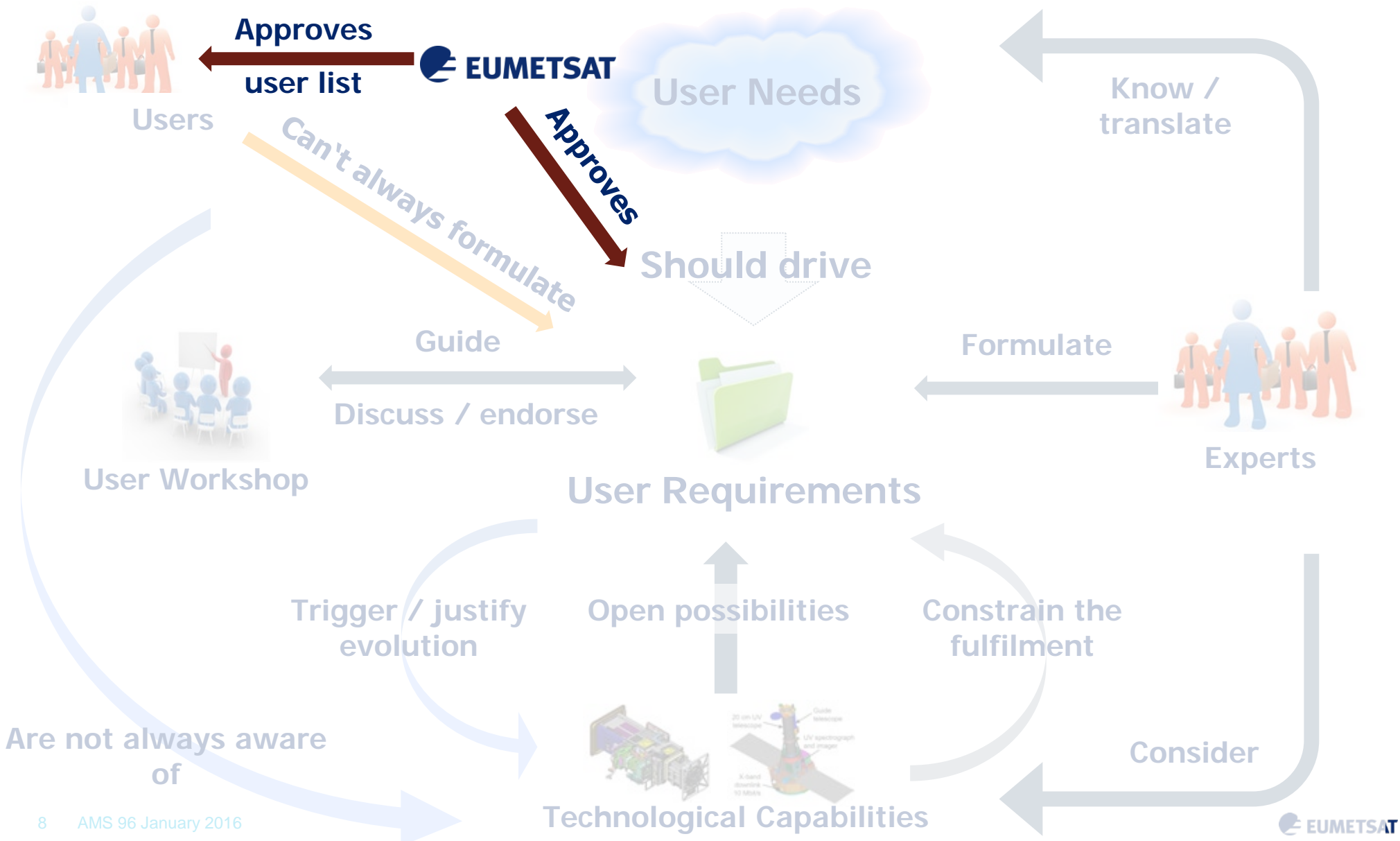
Process for user requirements elaboration



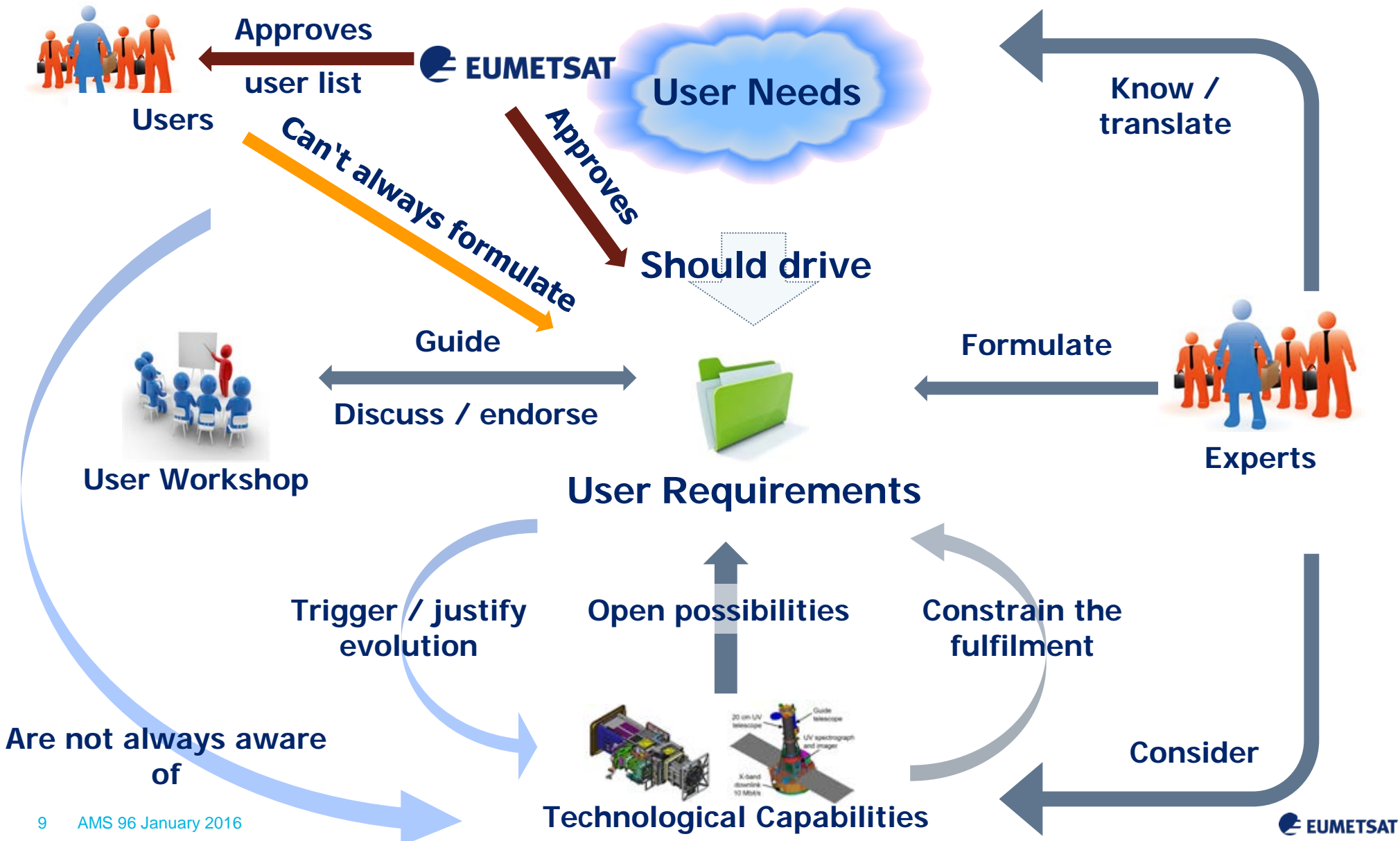
Process for user requirements elaboration

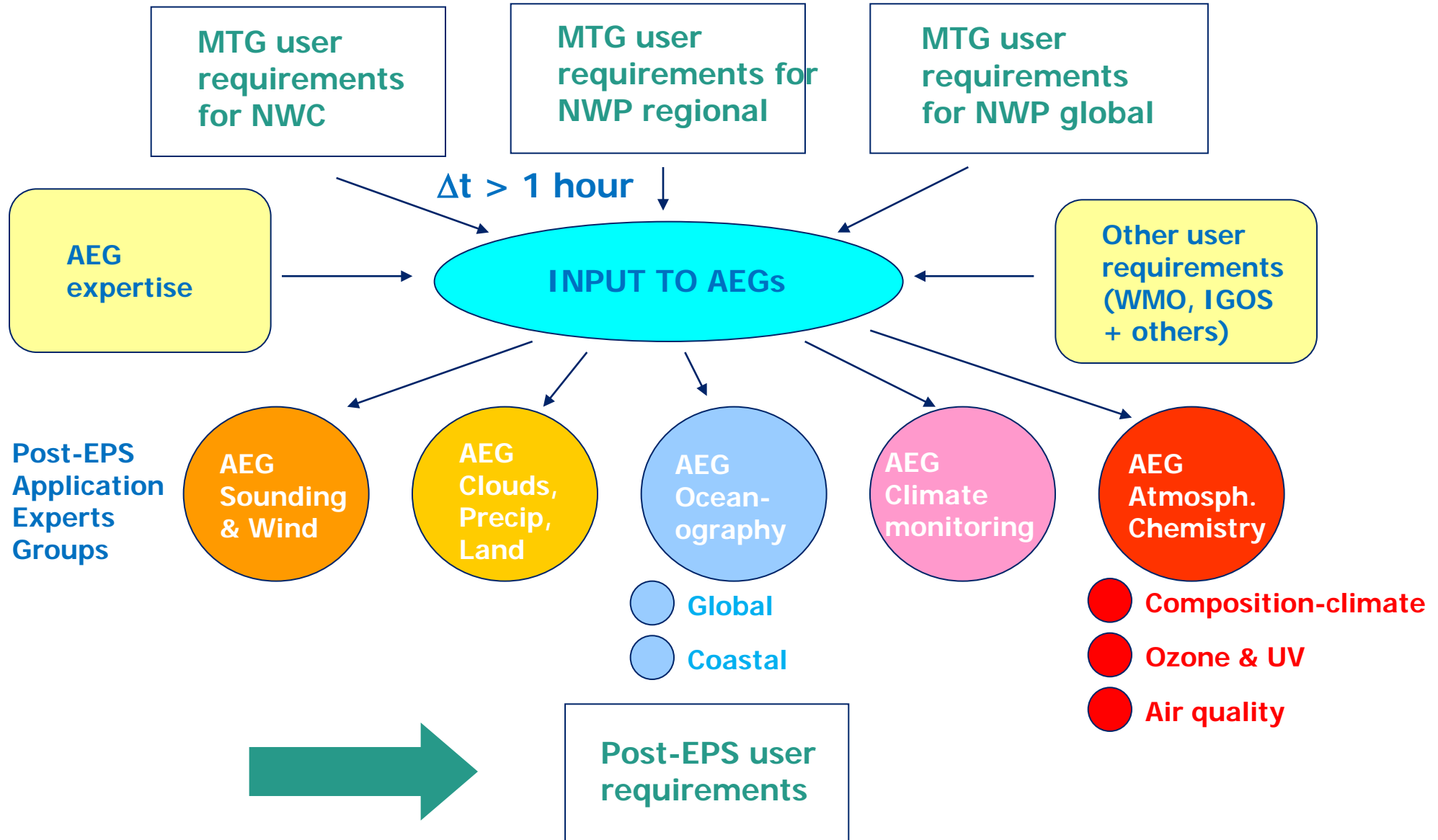


Process for user requirements elaboration

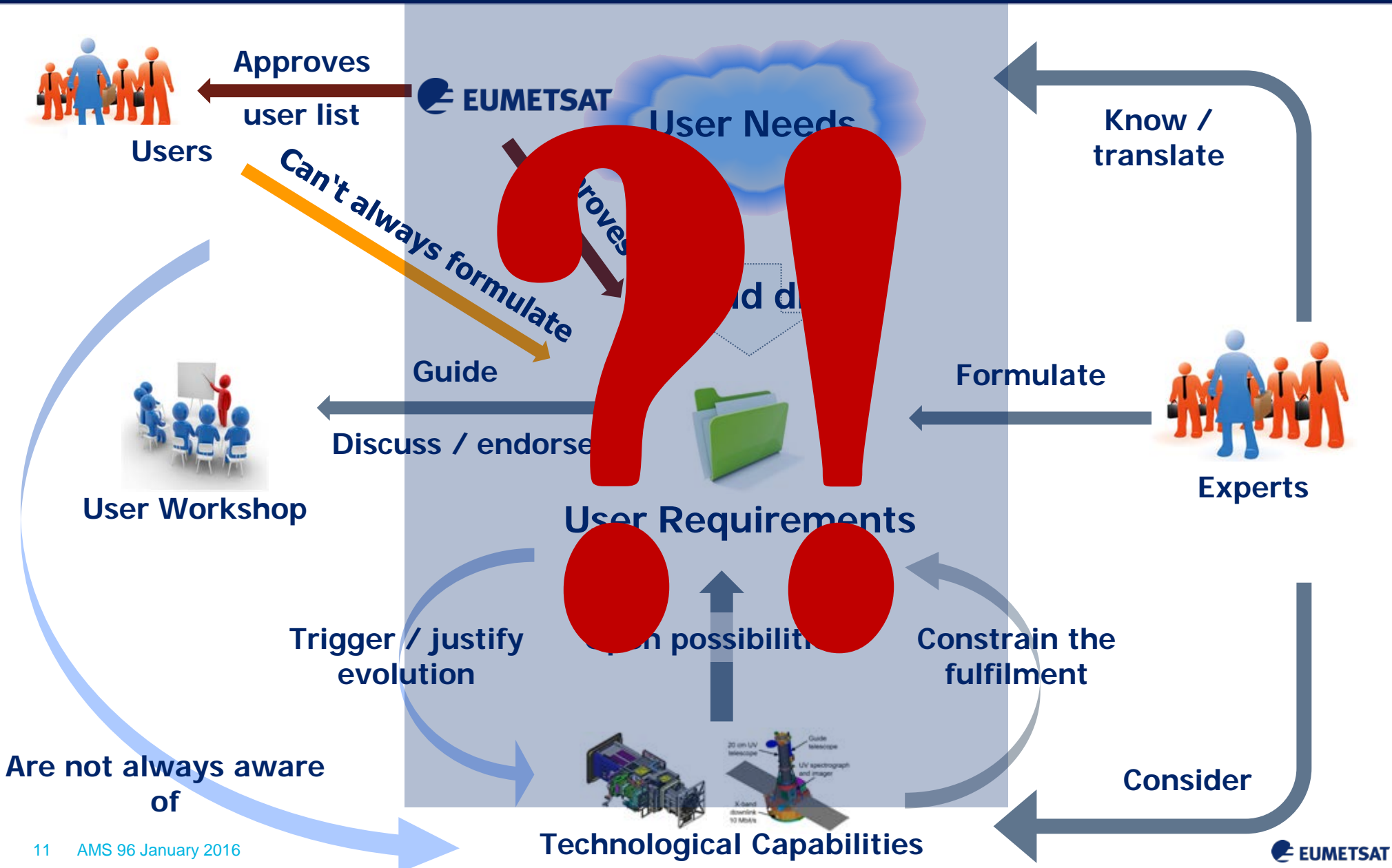


Process for user requirements elaboration





Process for user requirements elaboration



Science Maturity Index (1/2)

- Initiated by concepts developed for Climate data record Generation
 - (see e.g. Bates and Privette 2012)
- However, there are also significant technical aspects in the CDR maturity model, whereas here we are trying to assess the scientific maturity of the centrally derived products
- The proposed index is based on four major maturity categories:
 - Scientific Understanding
 - Modelling of the physical principals
 - Instrument capability and characterisation
 - Validation
- All categories receive an estimate:
- 3 = Highest achievable status, 2 = medium maturity and 1 = initial/immature
- The Scientific Maturity Index =
- Sum of the estimates per category (Max = 12, Min = 4)

Science Maturity Index (2/2)

- The purpose of the Index is to provide guidance on where efforts should be invested for future development.
- It is considered a useful complementary dimension based on an agreed assessment methodology.
- However, it is only one aspect that has to be considered.
- In addition the utility of the product for scientific application and exploitation has to be considered.
- Should also aid setting the overall priorities wrt to available resources..

An example for Metop Level-1 data

<i>Product Processing Facility (PPF)</i>	<i>Metop-A Status</i>	<i>Metop-B Status</i>	<i>Maturity Total (SU, M, ICC, VAL)</i>	<i>Remarks</i>
AVHRR Level 1	Operational	Operational	12 (3,3,3,3)	
AMSU-A Level 1	Operational	Operational	11 (3,3,2,3)	Some channel out of spec / failed
HIRS/4 Level 1	Operational	Operational	11 (3,3,2,3)	Some channels on Metop-B are at times out of specification
MHS Level 1	Operational	Operational	12 (3,3,3,3)	
IASI Level 1	Operational	Operational	12 (3,3,3,3)	
IASI L1 PCC	Operational	Operational	9 (3,2,2,2)	
ASCAT Level 1	Operational	Operational	10 (3,2,2,3)	
GOME-2 Level 1	Operational	Operational	11 (3,3,2,3)	Metop-A operating in 960km and Metop-B in 1920km swath mode.
GRAS Level 1	Operational	Operational	9 (3,2,2,2)	GO

Metop Level-2 Products (Derived at EUMETSAT HQ)

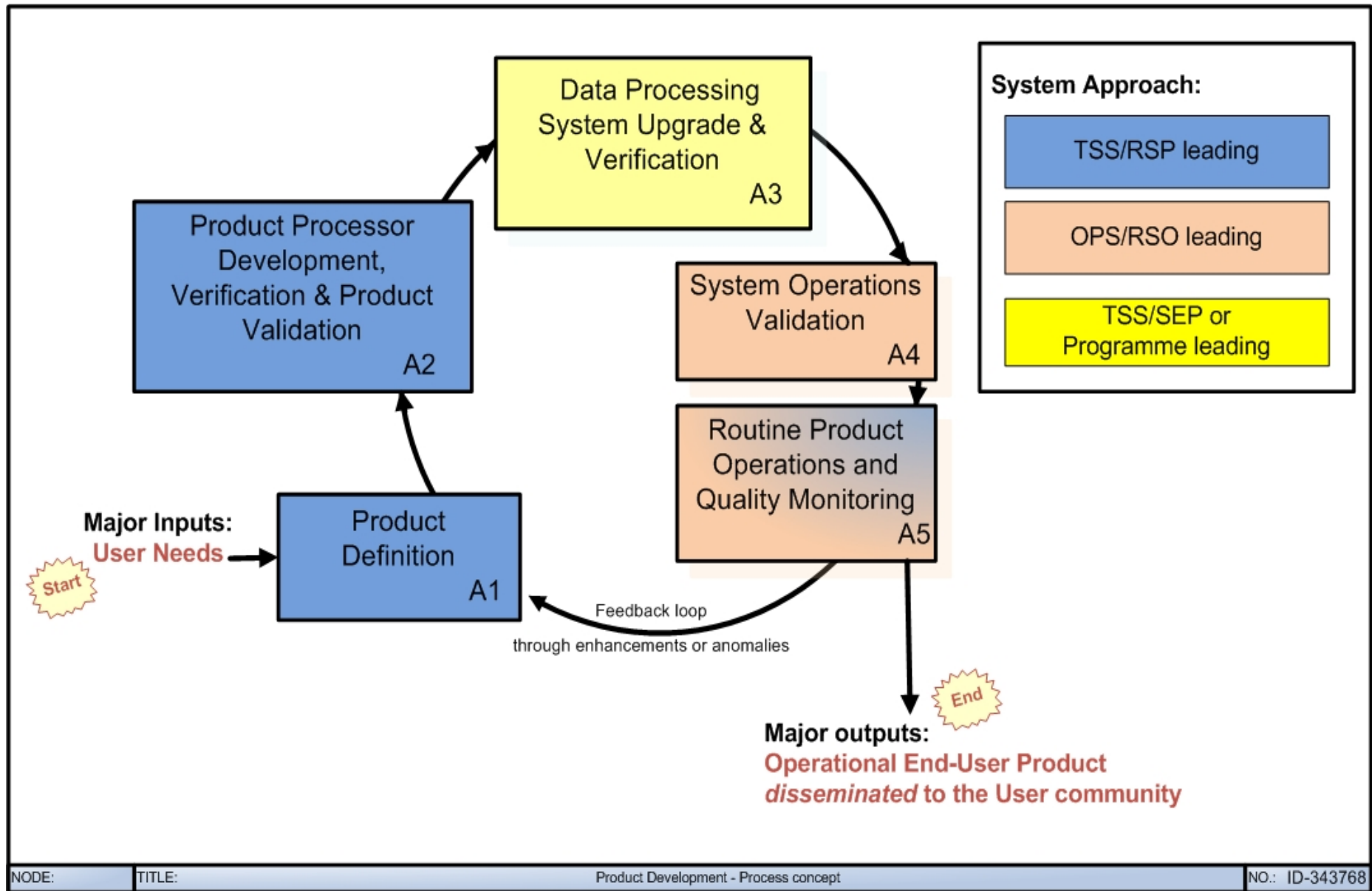
<i>PPF</i>	<i>Product Status</i>	<i>Maturity Total (SU, M, ICC, VAL)</i>	<i>Remarks</i>
IASI temperature and humidity retrieval	Operational	11 (3,2,3,3)	
IASI Ozone total column	Operational	11 (3,3,3,2)	
IASI CO profiles	Operational	10 (3,2,3,2)	Validation on-going with O3M SAF
IASI trace gases (ozone profiles, N₂O, CH₄, CO₂)	Demonstrational	7 (2,2,2,1)	Development started for CH ₄
IASI surface emissivity	Pre-operational	7 (2,2,2,1)	
IASI Cloud Parameters	Operational	11 (3,3,2,3)	
IASI SST L2Pcore	Operational	11 (3,3,3,2)	
ATOVS Level 2	Operational	12 (3,3,2,3)	Some degradation for Metop-A due to noisy or missing AMSU-A channels
ASCAT Soil Moisture	Operational	8 (2,2,2,2)	H-SAF product operated
Polar Cap Winds from AVHRR	Operational	9 (3,2,2,2)	
Global AVHRR Winds	Operational	7 (3,2,1,1)	
Triplet AVHRR Winds	Pre-operational	7 (3,2,1,1)	
Polar Multi-sensor Aerosol properties over sea	Operational	9 (3,2,2,2)	
Polar Multi-sensor Aerosol (y2) including land	Pre-operational	8 (3,2,2,1)	Validation on-going

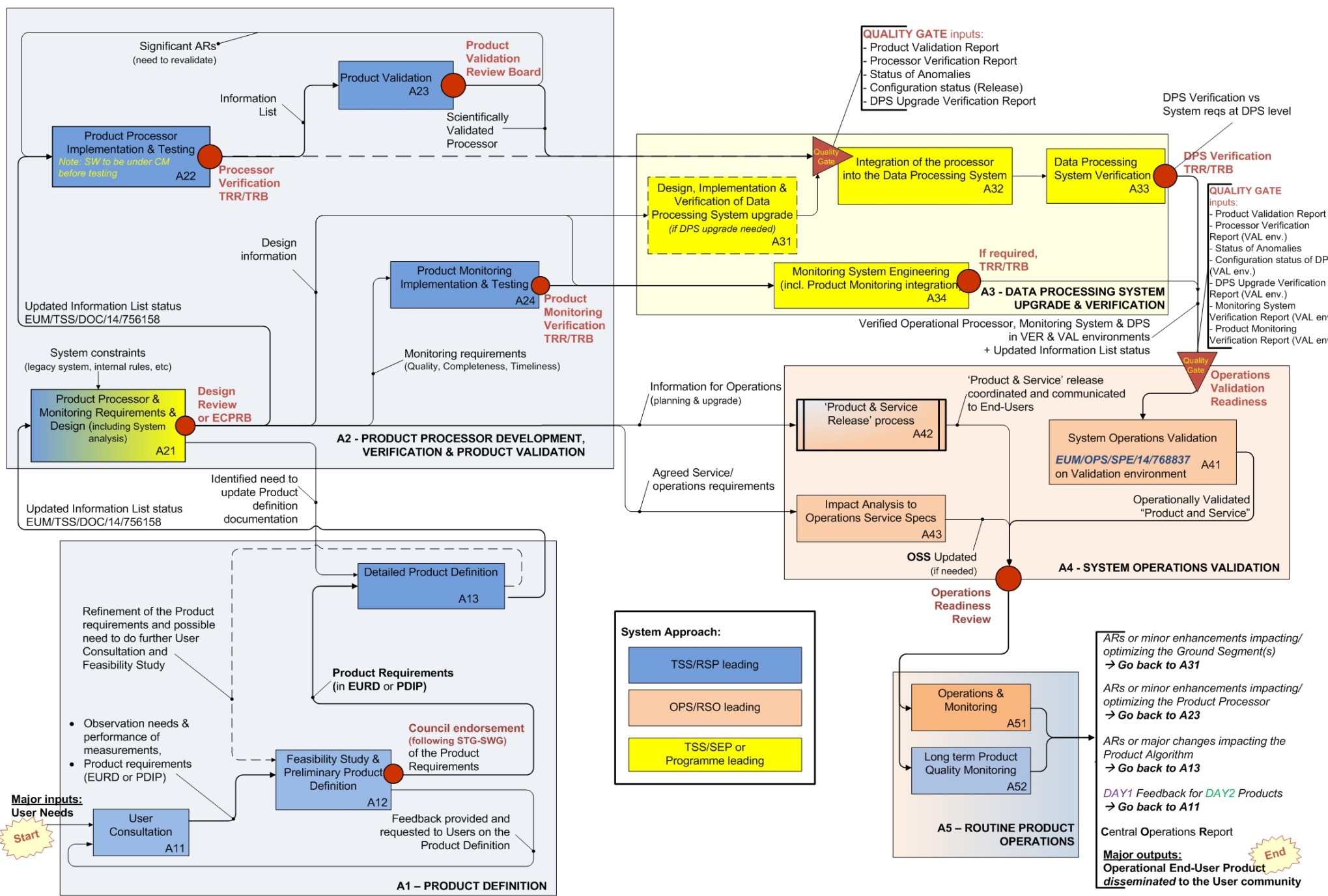
Science Readiness Level - Another matrix approach

Initial attempt (in coop with SAFs, DBs, ESA)– to be refined

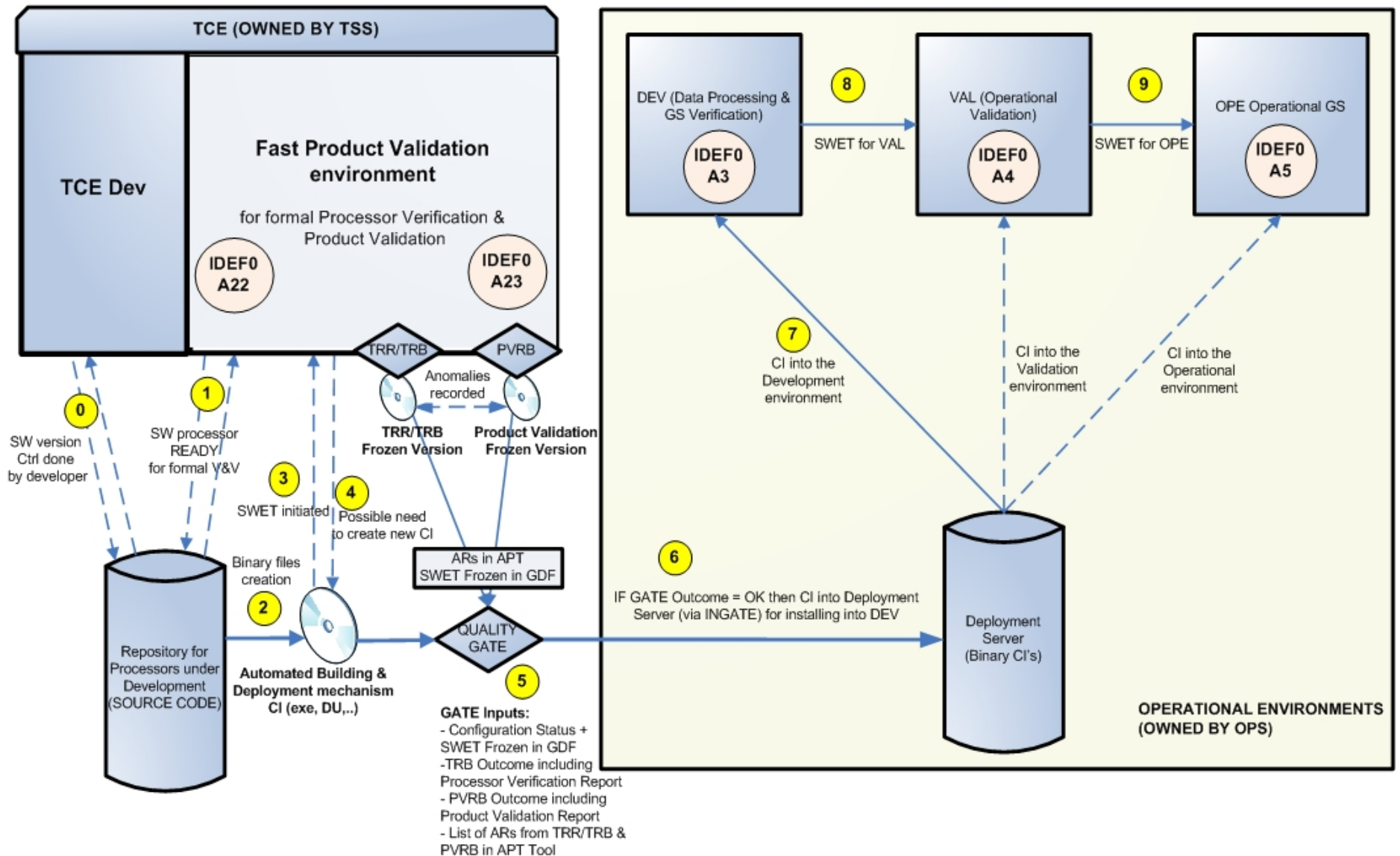
SRL	Name	Associated documents	Theory / Model	Observation	Validation / Verification	User
1	Scientific Idea		Scientific idea	Non	non	define Application Area Interest from Users
2	Conceptual Technique		Conceptual model, physical principal is clearly defined (no software is needed)	Gap analysis; complementary in observation system; uniqueness		Set high level draft EURD
3	Scientific / Observation Requirements	Mission proposal	Forward model is available (i.e. RTM simulation of measur.)		Initial capability assessment (Info content anal.)	Scientific requirements vs user requirements approved
4	Proof of concept	MRD	Consolidated approach 1 st sim. obs are available	Simulated measurements		Consolidated EURD
5	End-to-end performance simulations	Stable MRD, E2E (End-to- end simulator)	Consolidated retrieval and draft ATBD (+ prototype) are available	Demonstrator (e.g. airborne instr) “real data”	Calibration and Validation Plan established	Final EURD Committed Beta-User (e.g. through AO call’s)
6	Consolidated science and products (end: launch of sat)	ATBD’s	Final ATBD and operational processor / implementation	Pre-launch	Test data and sampled data processing	User studies with simulated or pre-cursor data
7	Demonstrated science (commissioning phase)			In orbit characterisations; perf vs. spec (EURD)	CAL/VAL conducted,; Early release of data; beta /demo data ava.	User feedback (validation team)
8	Validated and matured science(sat declared op)	Science feedback			Full validation	Operational validation and quality assurance via network
9	Science Impact quantification	Advancement in scientific understanding				User impact

Research to Operations Overview





Scientific Validation vs Engineering V&V



EUMETSAT Product Status

(NOAA and NASA have theirs too)

STATUS	DEMONSTRATIONAL	PRE-OPERATIONAL	OPERATIONAL
PRODUCT QUALITY	First version of the Product	Quality approaching to expected levels	Expected Quality (as per Requirements)
STATUS OF VALIDATION PROCESS	Limited Validation performed	Validation almost completed (if not completed), with documented limitations	Validation performed and fully documented
PRODUCT LIMITATIONS	Potentially unknown or Major	Known & Not Major or None	None or Known limitations agreed with Users
PRODUCT DOCUMENTATION	Product Validation report & User manual Not Available	Product Validation report & User manual (mainly) completed	All completed, published and available
AUDIENCE	Internal Users + Investigators Usually not more than a very limited set of users	Varying from 'limited set of Users' to 'All Registered Users'	Usually 'All Registered Users' (unless exceptions)
ACCESS BY EXTERNAL USERS	No Access to the Documentation	Documentation on the WEB	Documentation on the WEB

- We document our processes
- We have rolling 4 year product development and implementation plans
- We have long term technical evolution plans
- We monitor the progress
 - Organisational objectives, key indicators
 - With associated verification and validation reports
- Build on partnerships!
 - NOAA/EUMETSAT scientific collaboration is exemplary

Key Messages

- Consolidation of the real needs is difficult
- Establish user requirements carefully AND simultaneously define your V&V approach
- Explore the science, let it mature, but assess its maturity carefully
- Allow fast scientific validation in representative environments
- ...decoupled from engineering V&V
- Give consistent messages to the users
 - Agency coordination is mandatory!

Thank You
Questions?