

MATURATION OF A NEW TECHNOLOGY IN AERONAUTICS

Olivier De Vriendt
Research & Technology Manager
/ May 2012 /



AGENDA

- è **Context**
- è **NASA's maturation rating scale**
- è **Technology maturation plans**
- è **Test vehicles**
- è **Aircraft constraints**
- è **Development plan**



/01/

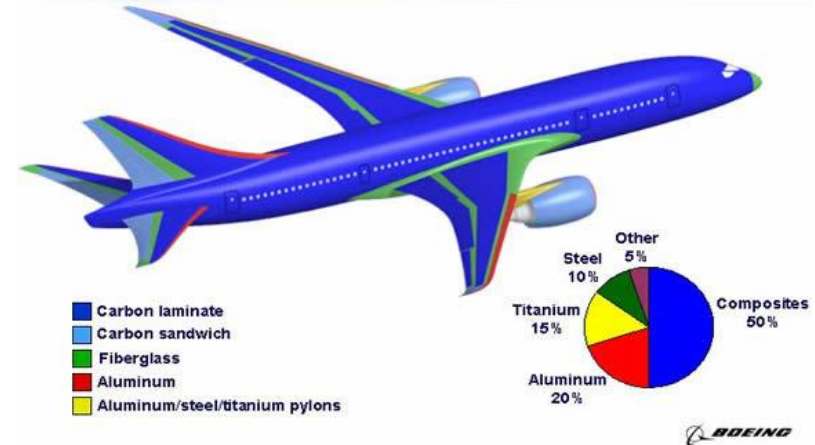
CONTEXT

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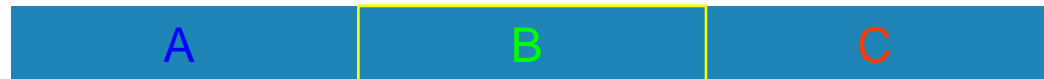
è **Aviation** : HIGH TECHNOLOGY - CRITICAL APPLICATIONS

è **Context**

- § Development times get shorter and shorter
- § The Time to Market of new technologies has become a key-feature



TECHNOLOGY



DEVELOPMENT



Warning ! Introduction of immature technologies !

/02/

NASA'S MATURATION RATING SCALE

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è Implementation of a maturation rating scale within SAFRAN

- § Directly derived from the NASA scale
- § Notion of Technology Readiness Level (TRL)
- § Rating scale used throughout the aviation in Europe

è Control of the technology maturation

- § Technology can be incorporated into a commercial development only after getting through these stages



The best practice is to reach the TRL6 to start in development

NASA'S MATURATION RATING SCALE

	TRL	Description		
• System / Subsystem Production	9	Actual System "Flight Proven" Through Successful Mission Operations	System Specific	
	8	Actual System Completed and "Flight Qualified" Through Test & Demonstration		
• System / Subsystem Development	7	System Prototype Demonstration in an Operational Environment		
• Technology Demonstration	6	System/subsystem Model or Prototype Demonstration in a Relevant Environment		Science & Technology
	5	Component and/or Breadboard Validation in a Relevant Environment		
• Technology Development	4	Component and/or Breadboard Validation in a Laboratory Environment		
• Research to Prove Feasibility	3	Analytical and Experimental Critical Function and/or Characteristic Proof-of-Concept		
	2	Formulation of Technology Concept or Application		
• Basic Technology Research	1	Basic Principles Observed and Reported		

NASA'S MATURATION RATING SCALE

Check list (Example)

Niveau de validation technique démontrée

- Performances fonctionnelles (cycle, d'un système...)
- Nuisances (bruit, NOx, SIR ...)
- Niveau d'intégrabilité dans l'environnement moteur
- Tenue mécanique dont DDV
- Masse
- Fiabilité
- Robustesse (expérimentale ou par simulation)
- Montage / maintenabilité
- Navigabilité

Réalisation

- Fabricabilité - Industrialisation du semi produit
- Maîtrise de la qualité - Contrôlabilité
- Maîtrise des coûts

Relation client

- Maîtrise du marché cible

Capacité de mise en œuvre

- Maîtrise du schéma industriel
- Maîtrise de la modélisation (la plus critique si plusieurs)
- Capitalisation des connaissances (PV, PC, COR...)
- Propriété intellectuelle (en conception)
- Propriété intellectuelle (en fabrication)

									Notation		
1	2	3	4	5	6	7	8	9	Remarques	Poids	Grille
	2										
		3								1	Standard
		3								1	Standard
		3								1	Standard
		3								1	Standard
	2									1	Standard
		3								1	Standard
			4							1	Standard
	2									1	Standard
	2									1	Standard
1										1	Standard
1										1	Standard
1										1	Particulière
1										1	Particulière
	2									1	Standard
	2									1	Particulière
		3								0.5	Particulière
		3								0.5	Particulière

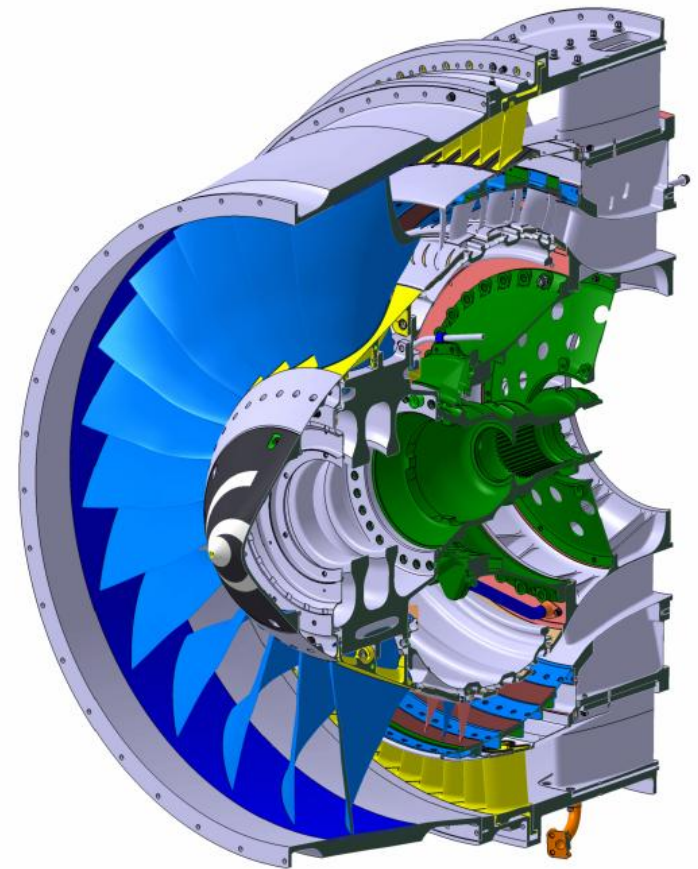
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TECHNOLOGY MATURATION PLANS (TARGET TRL6)

TECHNOLOGY MATURATION PLANS

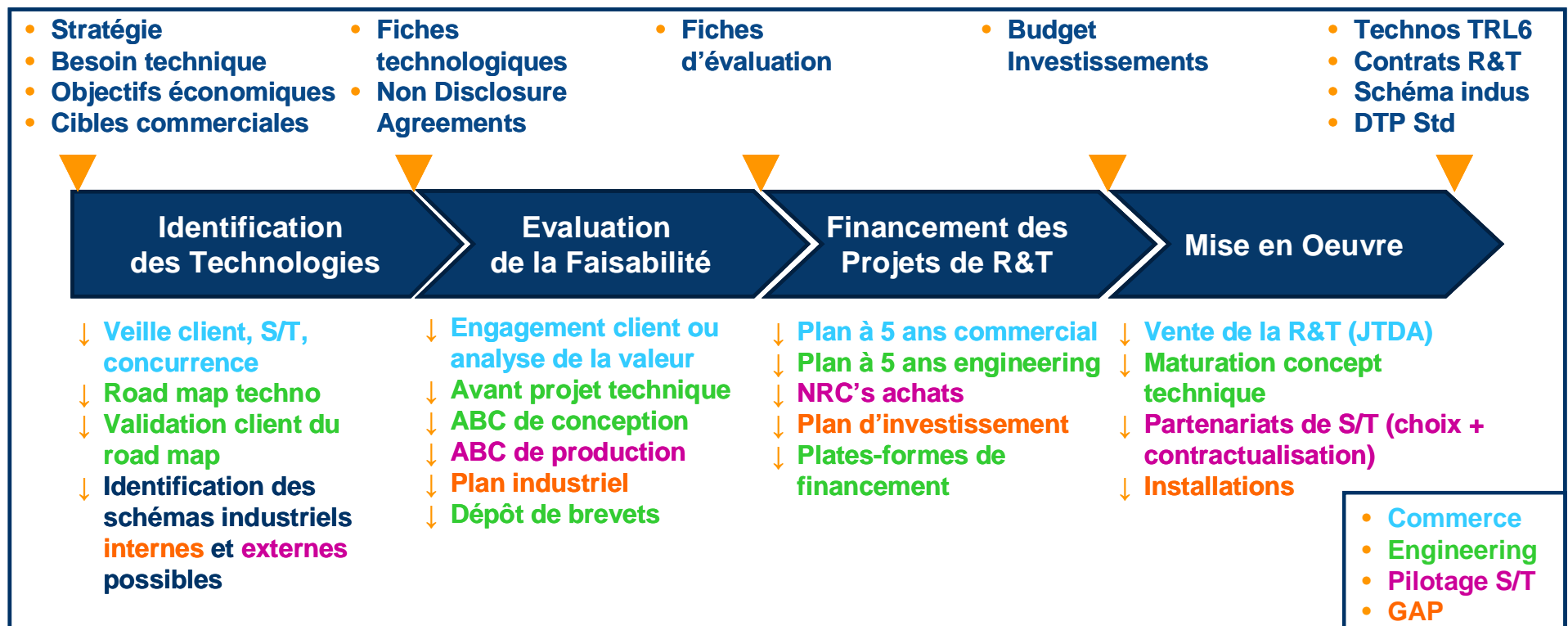
è Road Maps

- § The different areas of the company establish some technology road maps, which represent the key axis of progress and the timing associated
- § These road maps are passed on to the various company's areas who draw up their own road maps consistently according to their specific craft.
- § Then some projects are developed, which allow to climb the maturation steps. These projects are subject to an evaluation committee that confirms the interest of the project



TECHNOLOGY MATURATION PLANS

Project selection process



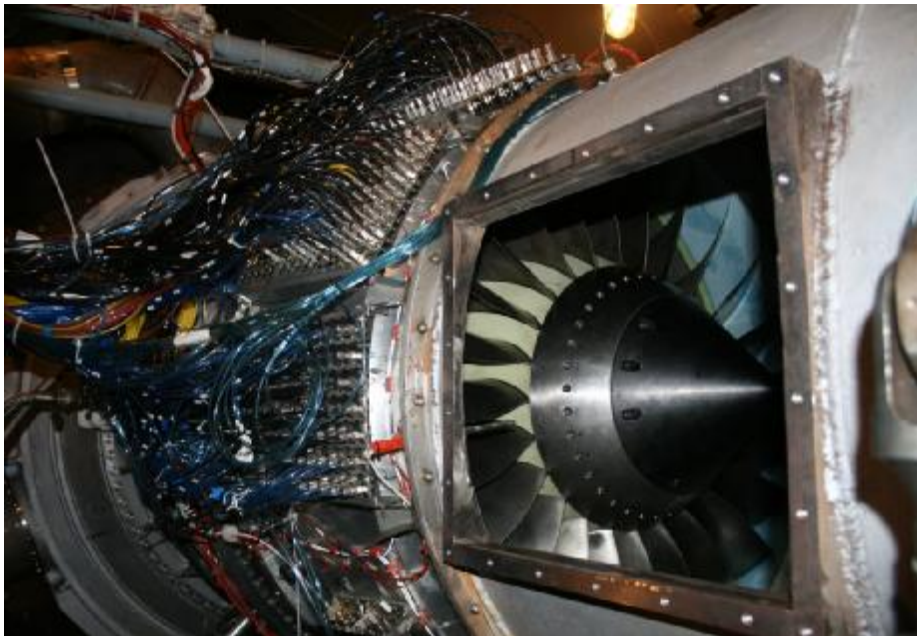
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TEST VEHICLES

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è Engine or system tests

- § > 2 to 3 years
- § To reach TRL 6, and thus be able to incorporate a key technology into a commercial development, it is necessary to test it in a representative environment
- § For a compressor, it concerns the realization of engine tests, or systems tests for exceptional load cases



- § The following step is the development of a demonstrator
- § This phase can usually be carried out in close collaboration with the engine manufacturer, which also allows us to arouse the latter's interest in our technologies

/05/

AIRCRAFT CONSTRAINTS

AIRCRAFT CONSTRAINTS

è Context

- § We do not transport people without special authorization

è Certification

- § Aircraft is subject to very strict procedures of commissioning of the products, in order to guarantee the security of the transport
- § Certification, maintenance and repair through FAA or EASA

è Life cycle

- § Commissioned airplanes and engines often have lifetimes of over 30 years
- § The development of a new commercial product alone represents 4 to 5 years in using shelf-technologies (TRL 6)
- § The opportunity to commission new technologies is relatively rare



NAVIGABILITY

è Which are the rules ?

§ 200 Airworthiness standards



§ FAR 25 Aircraft

CS-25

§ FAR 33 Engine

CS- E

§ FAR 21 Certification

Part - 21

§ FAR 145 repair stations

Part - 145

è **The manufacturer has to incorporate the legal requirements into a formalized validation plan adapted to his product**

High level requirement to ensure that the passenger arrives SAFE

/06/

DEVELOPMENT PLAN

DEVELOPMENT PLAN

è Aim

- § Check if there was no problem on the product developed

è How

- § Design reviews
- § Certification tests



MIRABEL ICING TESTING



HAILSTORM TEST



MEDIUM BIRD TEST SET UP



FTB STATISTICS



HAVE YOU GOT ANY QUESTIONS ?