



**Dr. Jean Botti**

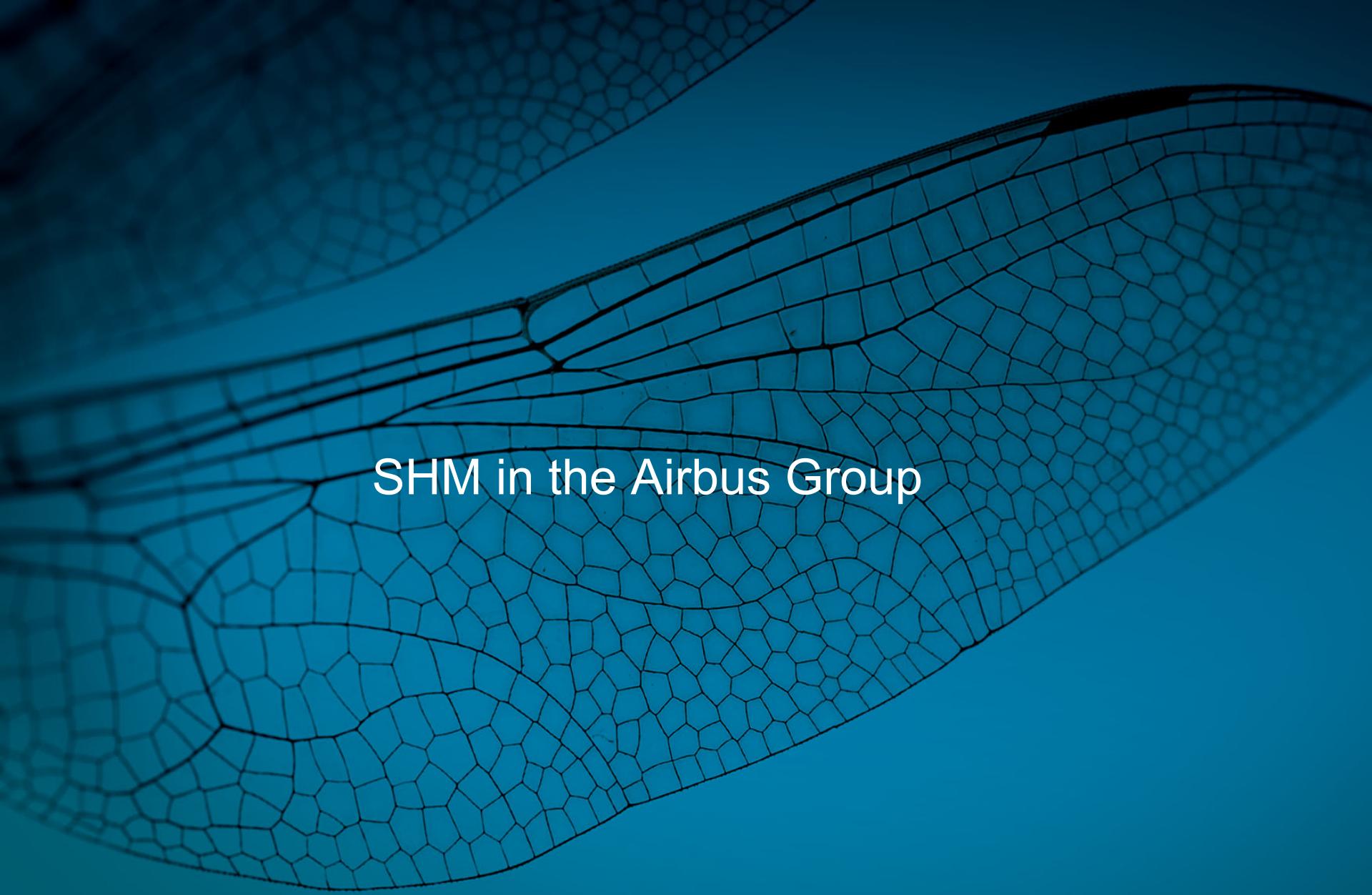
**Airbus Group Chief Technical Officer**

**Keynote**

**10<sup>th</sup> International Workshop on Structural Health Monitoring 2015**

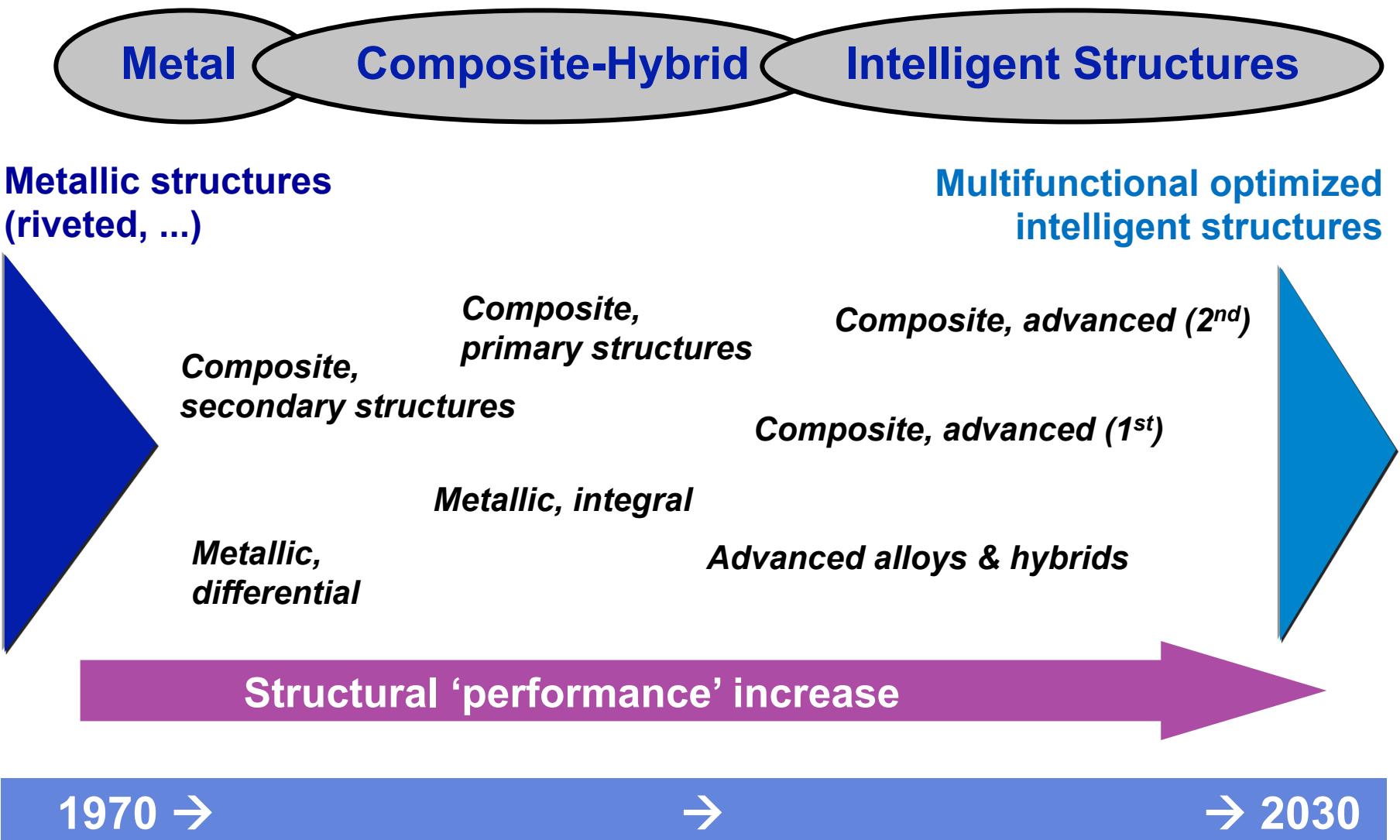
Stanford University  
September 1, 2015

**AIRBUS**  
GROUP



# SHM in the Airbus Group

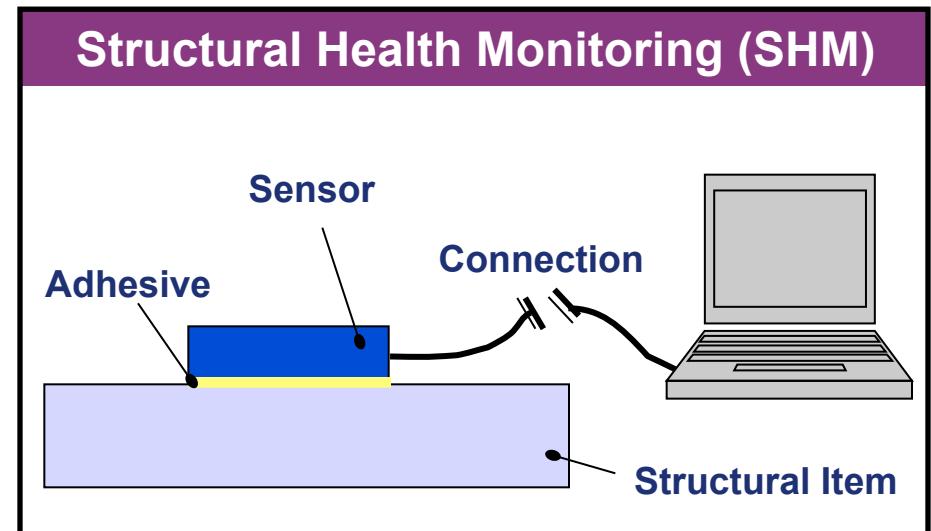
# SHM within the Evolution of Airframe Structural Design



# The intelligently “sentient” aircraft

## Goals of Structural Health Monitoring

- Reduce Maintenance Costs
- Increase Aircraft Availability
- Reduce Weight



**SHM = Onboard NDT of Defects, Damages, Stress, Conditions**

## Examples for Running SHM Projects in Airbus Group



**Tail strike indication system  
now deployed on the A380  
A380 full-scale fatigue test  
The A350 used SHM during structure  
certification and flight testing**

**The Life-Time Monitoring System  
(LTMS) is an optional installation  
on the A400M**



**Integration of Onboard SHM system  
as part of the Integrated Vehicle Health  
Management System**

**Health and Usage Monitoring Systems  
(HUMS) in helicopters**



# Airbus Group Divisions' Contribution to Support the E2E Value Chain



## Project: @MOST

**Airbus Total Maintenance Operations Services and Technologies**



## Project: NG HUMS

**Airbus Helicopter Next - Generation HUMS**



## Project: HMM @ Airbus DS

**Integrated System Health Management**

### TECHNOLOGY FOCUS

- Reliable aircraft health status (current and predicted) / including SHM
- Optimized maintenance scenarios from Aircraft and Fleet condition
- Remote Maintenance capability proprietary document.
- Contextualized and dynamic documentation
- Full Aircraft Configuration available “on demand”
- Integrated and Cost-effective end-to-end maintenance operations

- Reliable aircraft health status (current and predicted) / including SHM
- Automated Customer Data Collection
- Customer Data Management
- Usage & health-based Maintenance Management
- Condition based Maintenance (Maintenance Credit)

- Reliable Aircraft Health status (current and predicted) / including SHM
- Data-driven and model-based Diagnostic
- Data-driven and model-based Prognostic
- Condition based Maintenance (Maintenance Credit)
- Open System Architecture for Condition based Maintenance
- Simulation based CBM V&V Framework

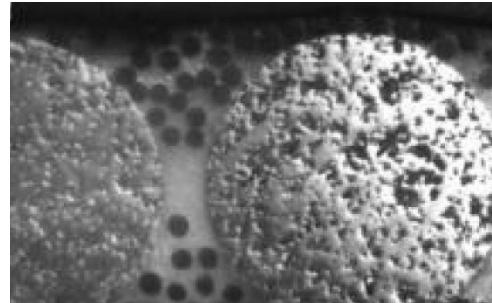
# Roadmaps for SHM in the Airbus Group Divisions



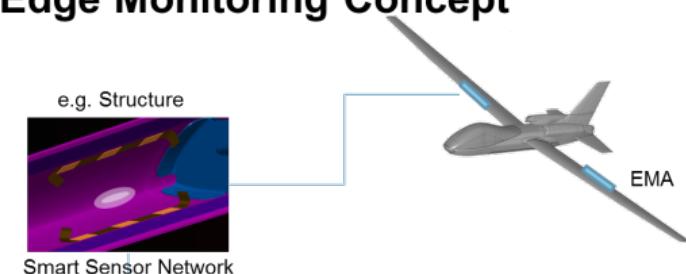
# Critical SHM-related Technologies Currently Elaborated by Airbus Group

## Sensor Application

- Surface Application
- Embedded Sensors
- Sensor Network
- Network Management
- Functional Structure



## Leading Edge Monitoring Concept



## SHM - / HMM Architecture

- On-board Maintenance System
- Off-board Maintenance System
- Mission Management System

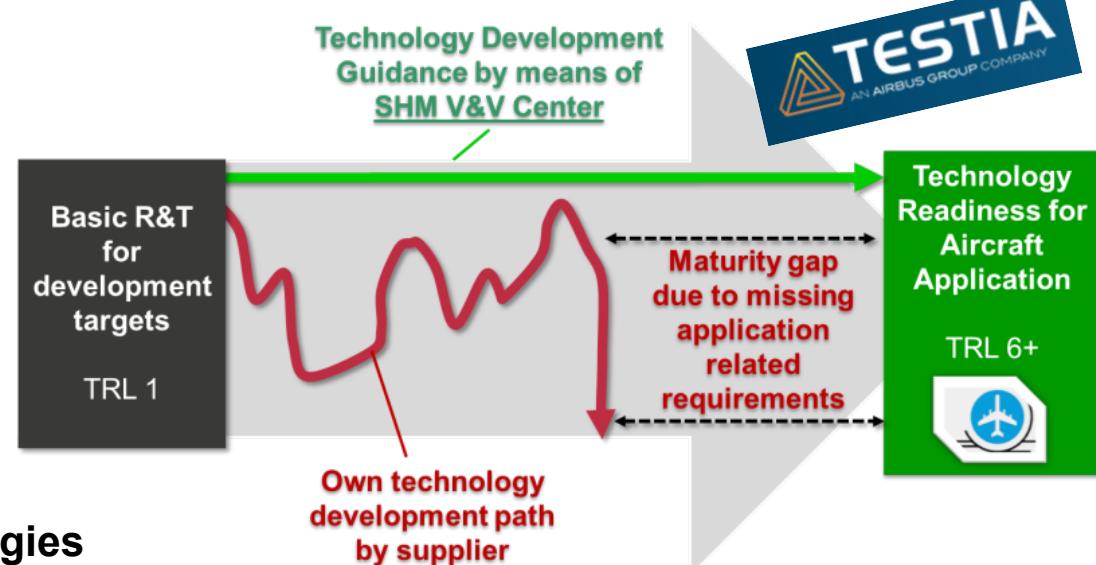
## Certification

- Probability of Detection
- Reliability of Information

## Big Data

- Data organisation and storage
- Data processing: select technologies and frameworks for data processing, visualisation
- Data analytics: correlation, fusion, specific algorithms, ...

## Piezoelectric composite



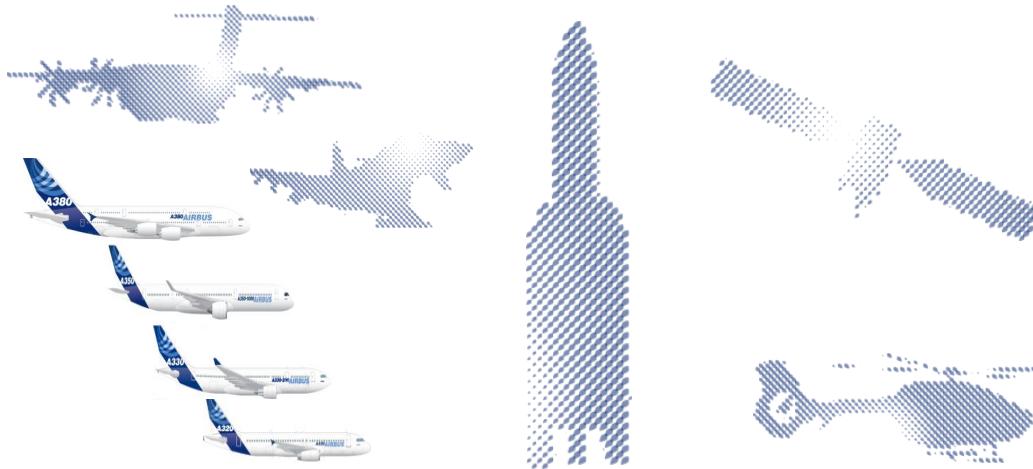


**BIG DATA at Airbus Group**



# BIG DATA - beyond SHM

## Flight Test Analysis Flight Operations Support



Maintenance, Diagnosis, Prognosis

Fleet / Constellations Management

**... and probably many others to come.**

**R&T have to provide innovative solutions to create the expected value out of the data**



Cyber Security\*



Intelligence, Imagery data

Ground Operations

## We are sitting on a huge amount of data we do not fully leverage

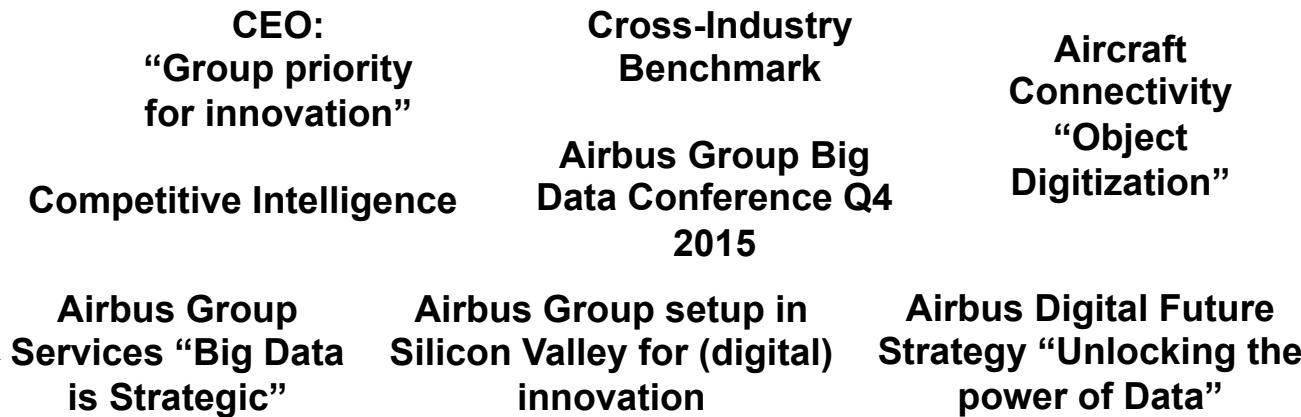
Example: Aircraft Operation Data

		Stored & limited use			Not stored & not used			Total Fleet / year	
		A/C In-Service Data		Take-Off / Year	Total Fleet / year	Total Fleet / year	Total Fleet / year		
		Std ACMS	Potentially Recordable						
<b>A350</b>		<b>670 000</b>	<b>4000</b>	<b>400 000</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>		
		#Parameters	450 TB produced for the certification process in 2014	Data Recorded/flight	<b>500 GB</b>	<b>450 MB</b>	<b>300 GB</b>		
<b>A380</b>		<b>320 000</b>	<b>4 000</b>	<b>400 000</b>	<b>5.800</b>	<b>2,6 TB</b>	<b>1,1 PB</b>		
		#Parameters		Data Recorded/flight	<b>250 GB</b>	<b>450 MB</b>	<b>200 GB</b>		
<b>Long Range</b>		<b>14 000</b>	<b>1 500</b>	<b>40 000</b>	<b>84.000</b>	<b>17 TB</b>	<b>2,5 PB</b>		
		#Parameters		Data Recorded/flight	<b>10 GB</b>	<b>200 MB</b>	<b>30 GB</b>		
<b>Single Aisle</b>		<b>12 000</b>	<b>1 500</b>	<b>13 000</b>	<b>744.000</b>	<b>37 TB</b>	<b>9 PB</b>		
		#Parameters		Data Recorded/flight	<b>10 GB</b>	<b>50 MB</b>	<b>12 GB</b>		

x 50 in ~30 years (Flight tests)

# BIG DATA Understanding and Maturity within Airbus Group

Top down



More & more strategic drive to get business value out of our data as an asset

## Digital and Big Data is a Group priority for 2015

Internal benefits through new / increased revenue and efficiency gains  
Game changer on the market / Opportunities & Threats to be considered

Bottom-up

Flight Tests A350 RC  
Aircraft Visibility POC  
R&T studies BIO  
*Mono-Domain & fragmented Quicker or nicer*

ECO-Fly POC  
Predict Non-Quality (XQ-Data POC)  
Flight & Ops Data Hub POC  
TTGF POC  
*Cross-Domain and federated Showing impacts on company essentials*

More & more business value demonstrated by doing

# Positioning BIG DATA within the Entire Digitalization Scope



1 Mix the appropriate technological solutions ...

Big Data & Advanced analytics

Internet of Things

3D everywhere

Augmented Humans & Robots

Social & Collaboration

2

... with clear business opportunities or problems...



Use digital to improve Products or Customer experience



Use digital to improve internal Operations



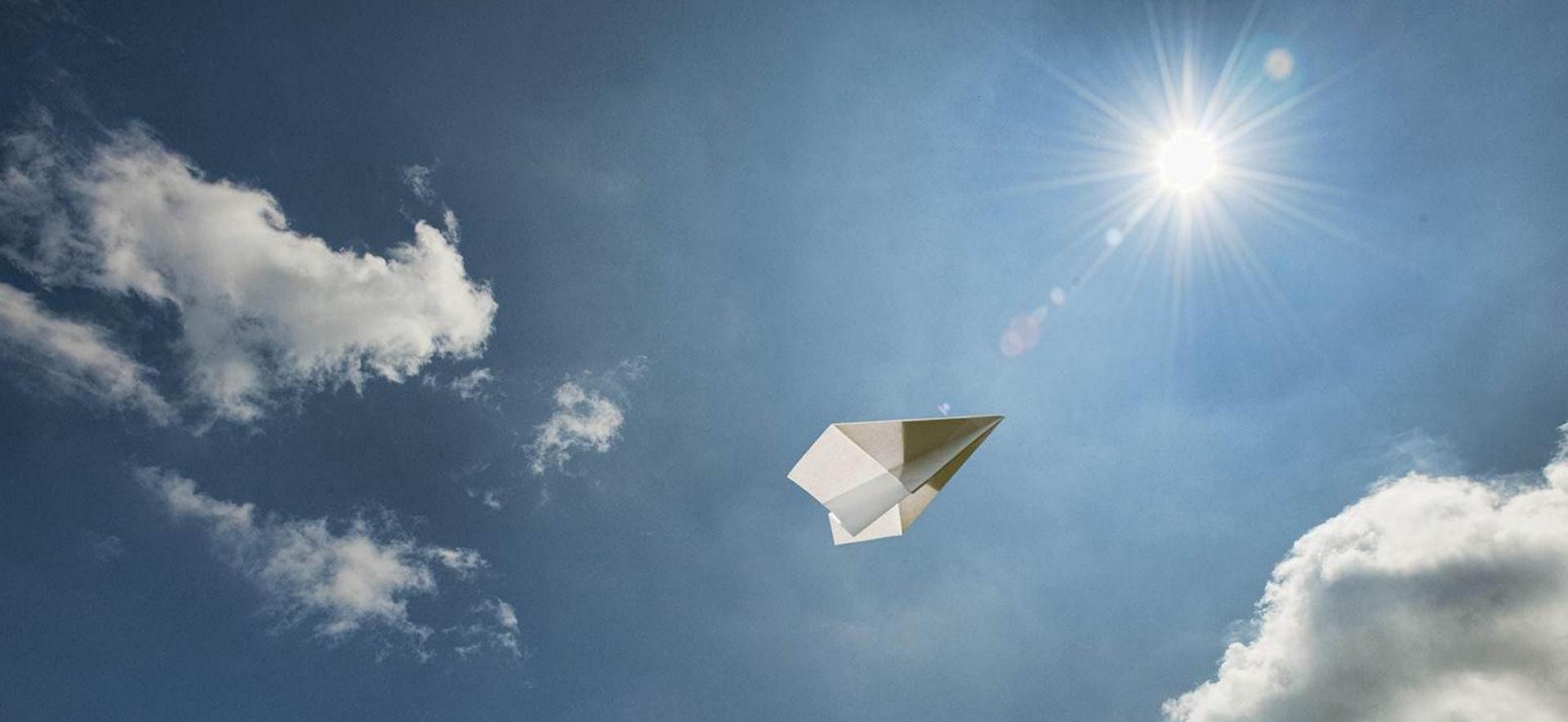
Use digital to improve Organisation & Culture

3

... and with the right mindset to create tangible business value

Illustrative

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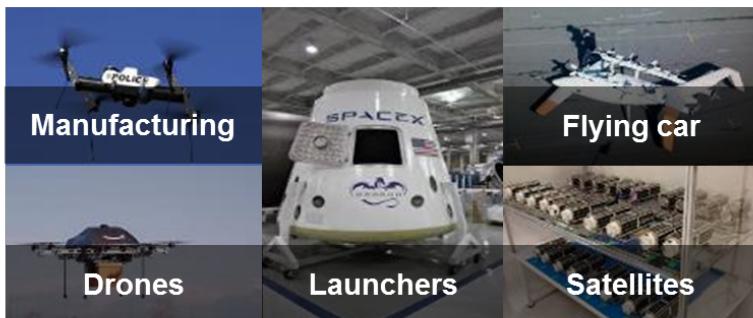


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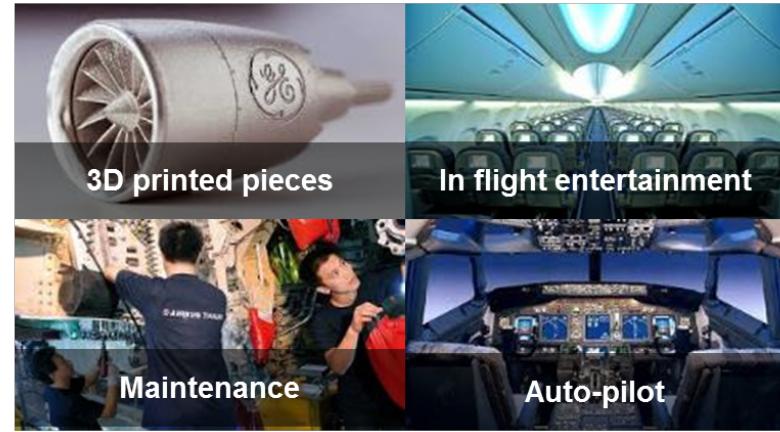
# The Airbus Group Innovation to Business Center in the Silicon Valley

# Silicon Valley is Making In-roads into our Core Market

## Disruption of the current business



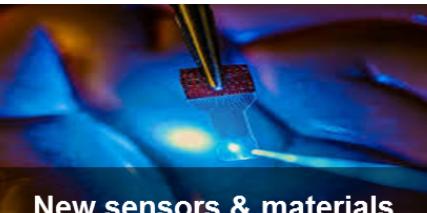
## Improvement of the current business



## Massive investments in key technologies and innovation enablers



Virtual reality



New sensors & materials



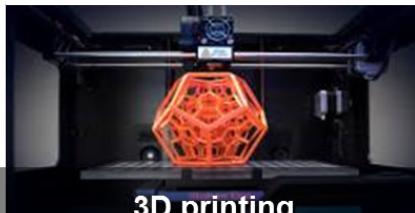
Big data



Autonomous vehicles & robotics



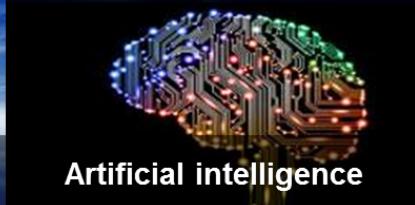
Crowdsourcing



3D printing



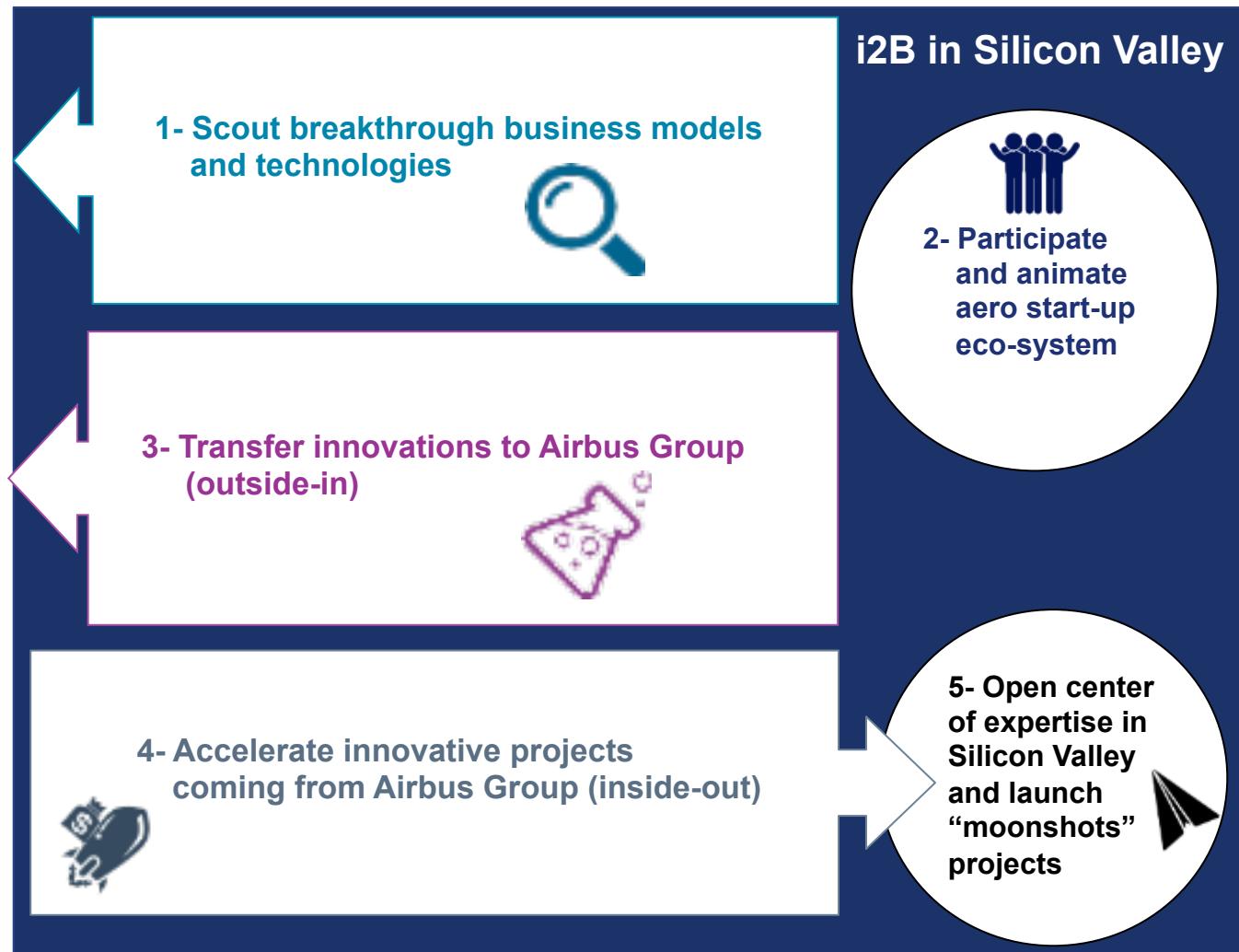
Energy storage



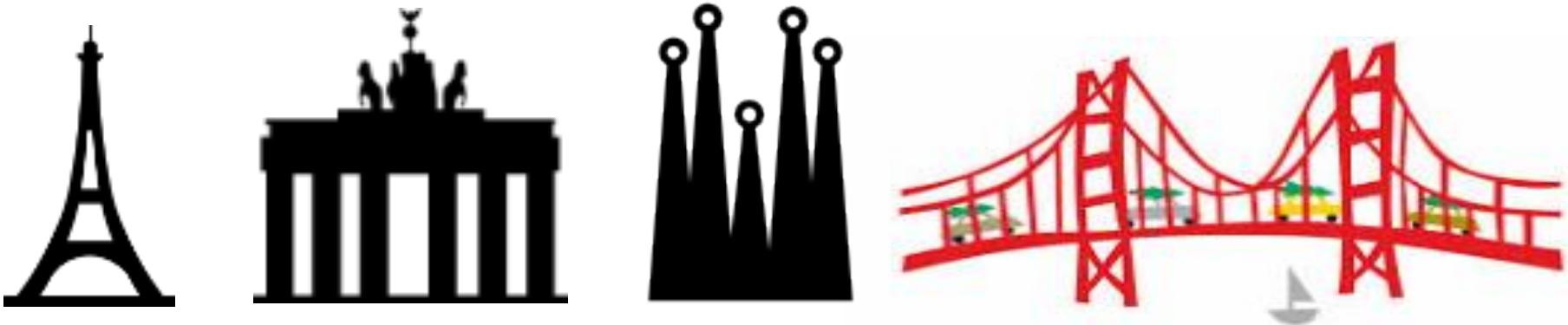
Artificial intelligence

# The i2B Fosters Innovation to Business for Mothership Airbus Group

Mothership company  
in Europe



## The Airbus Group Innovation to Business (i2B) Center in the Silicon Valley



# The Fully-Electric E-Fan Crossed the Channel on July 10, 2015



# Thank you for your attention

