



INTERNATIONAL CONFERENCE  
Simulation Process & Data Management

# CERBER, an SPDM Proof Of Concept based on OpenSPDM Bearing design for Aircraft engines

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# SAFRAN Group



(12/31/2018)

AN  
INTERNATIONAL  
HIGH-  
TECHNOLOGY  
GROUP

## 5 CORE BUSINESSES:

Aerospace propulsion  
Aircraft equipment  
Defense  
Aerosystems  
Aircraft interiors

## WORLD'S No.3 AEROSPACE COMPANY

(excluding aircraft  
manufacturers)

More than **92,000**  
**EMPLOYEES** in  
**30 COUNTRIES**

**€21 BILLION**  
in revenue

**€3 BILLION** in  
adjusted recurring  
operating income

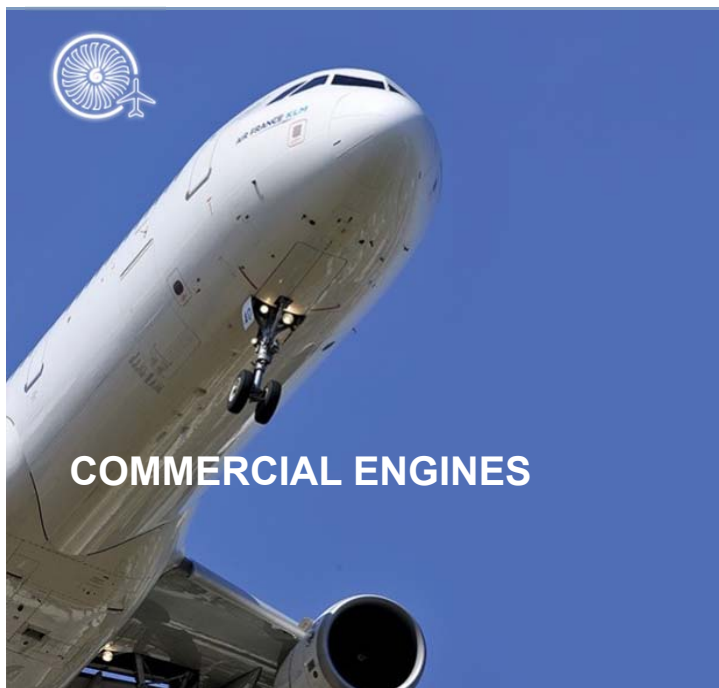
**€1.5 BILLION**  
in R&D expenditures

**850 INITIAL  
PATENTS**  
filed\*

\*in 2017

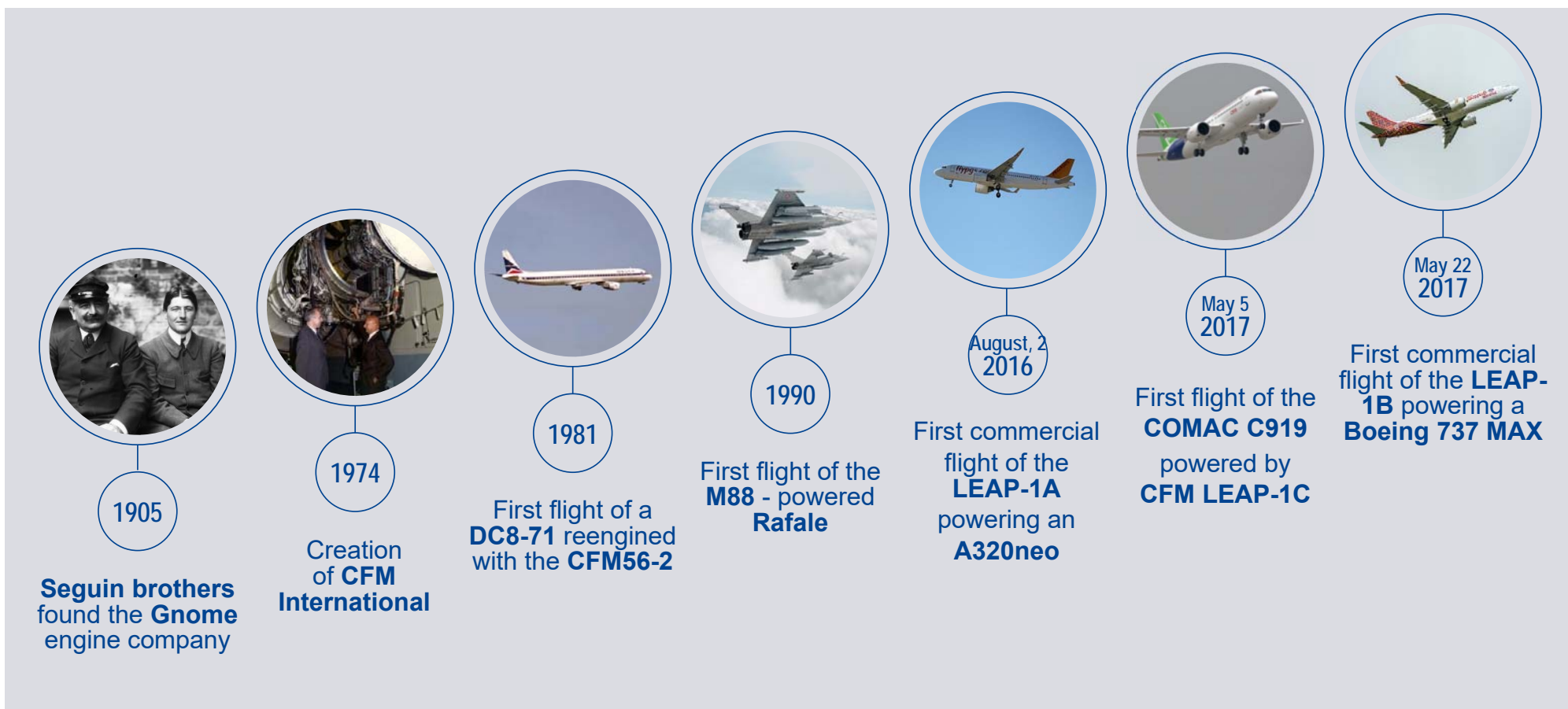


# Safran Aircraft Engines



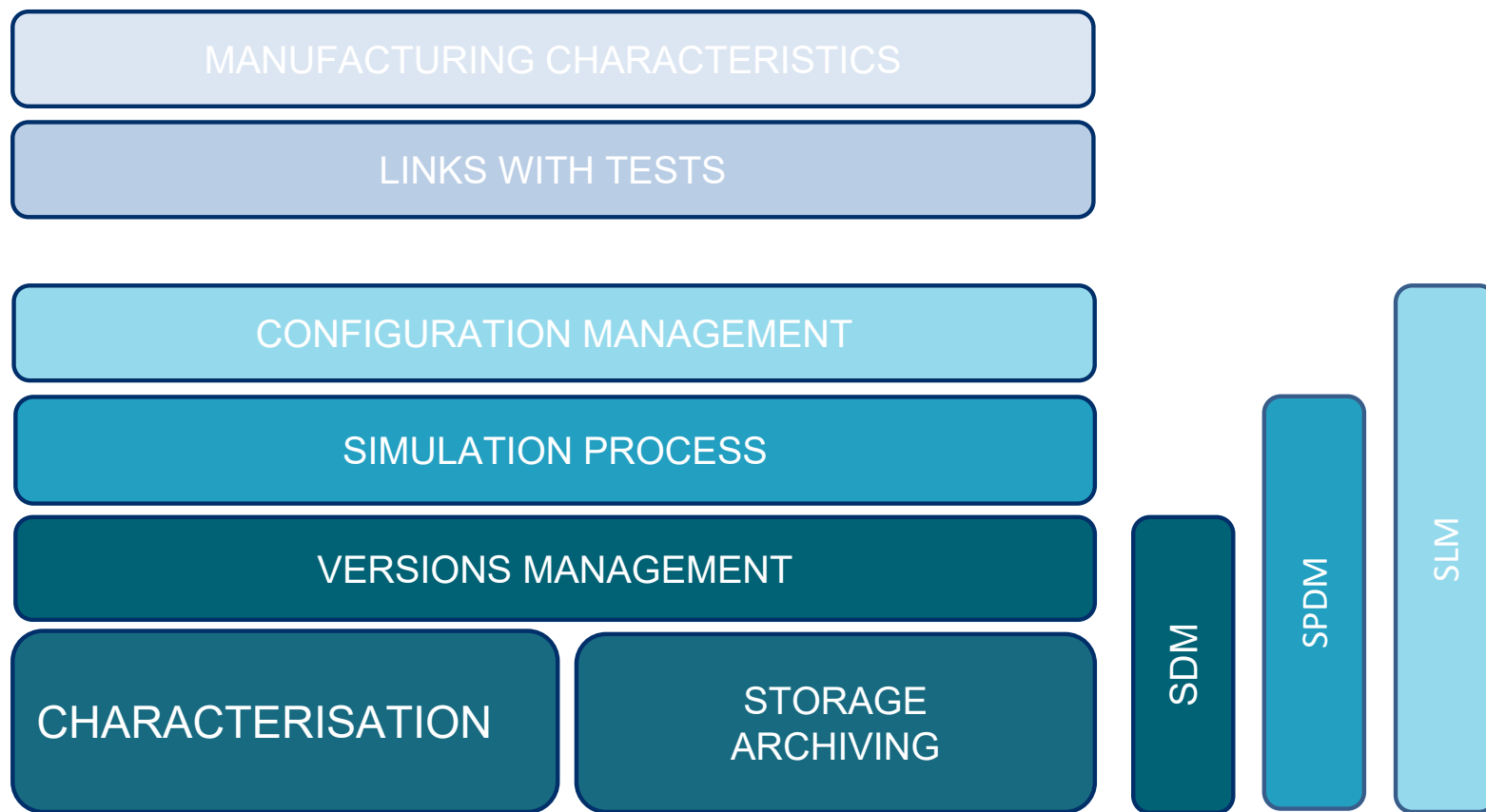


# Aviation pioneer for more than 110 years





# Safran Aircraft Engines SPDM Strategy



↳  
ID cards in  
repositories



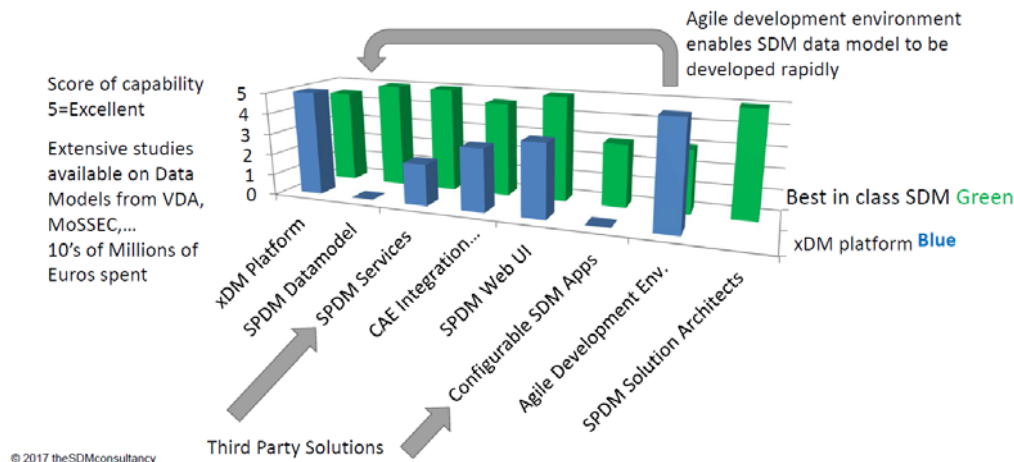
# CERBER genesis : a first SPDM POC

- Methods & Tools Department requested to provide a way to manage data more efficiently around bearing simulation
- Exchanges with M. Norris on SPDM knowledge
  - Few editors & cost of POC
  - No Open Source solution available
  - OpenSPDM initiative launched by Mark with demonstrator available
- OpenSPDM identified as an opportunity to answer Safran Aircraft Engines users request with limited investments & ability to deliver a product to test in short terms & accessible for SPDM « newbies »



# openSPDM

- SPDM data-model & services can be built rapidly on an agile xDM Platform
- Availability of ARAS Innovator as Open Source solution
- OpenSPDM designed as a community solution on the ARAS Innovator Platform, with the help of Inensia, available through the **openSPDM** consortium



aras  
**INNOVATOR**®

openSPDM

 inensia  
Digital Industry Services



# CERBER – openSPDM Proof of Concept



**CERBER**  
Conception et Etude de Roulement  
à Billes Et à Rouleaux \*

\* Ball & Roller Bearing Design & Study





# The previous context of the bearing data & process management

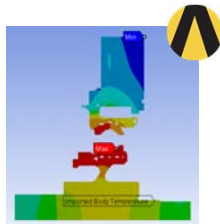
- The bearing design for aircraft engines use efficient tools developed with research laboratory and based on semi-analytical methods



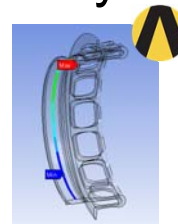
**Ball Bearing**  
Quasi-static analysis



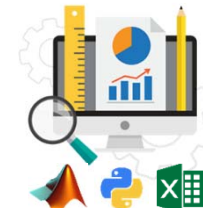
**Roller Bearing**  
Dynamic analysis



**Structural deformation**  
model (FEM)



**Clearance analysis**  
(FEM)



**Analytics and**  
**Visualisation Tools**



**1 simulation run**  
**~ 1-2 min**  
**(~ 10 min FEM)**

- The file system is the internal data manager except for the CAD product

- Many input files are necessary to run bearing simulations
  - Continuous modifications of these files after an update of conditions without change tracking
  - Source of many input errors and misunderstanding
- AND Data must remain accessible during the whole aircraft engines life (~ 30-40 years)
  - Links between submission Data and their search is very time consuming



**1 data analysis**  
**~ 2-3 days**



# Benefits expected from SPDM for the bearing data & process management

- The project target consists on building a bearing database with a platform to :
  - Recover all elements needed for bearing design
  - Run a design process with automatic input/output exchanges between simulation tools
  - Suggest a new bearing respecting the design practices and processes for validation lifecycle
  - Suggest results analysis with 3rd party solutions and automatic reporting (template for study)
  - Manage bearing lifecycle for all studies classified by a triptych Engines-Type-Location (Part Number)

**“Get it right at the first shot”**

**“Share input/output data and knowledges as well as design practices”**



# CERBER – Demo



**CERBER**  
Conception et Etude de Roulement  
à Billes Et à Rouleaux \*

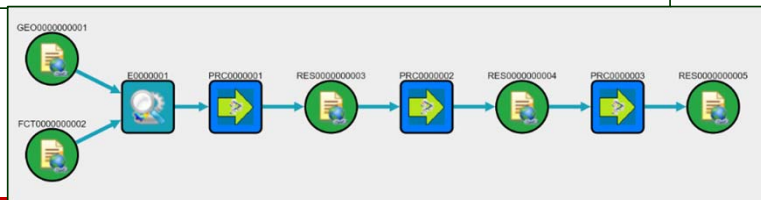
\* Ball & Roller Bearing Design & Study



# CERBER solution enables simulation data management and traceability

- Data Model has been extended to support study templates for chaining the Simulation tools (server & client)
- **openSPDM** graph displays all the dependencies from a result

Assemblage Properties	_Nominal	_Tolerance	_Abbreviation	_Unit
Diamètre Moyen	124.3		Dm	mm
Diamètre des éléments roulants	18.3		d	mm
Nombre d'éléments roulants	17	not applicable	Z	n/a



S1_StudyTree	Type	Cond. Fonct.	Current State
CLM0000000098	Condition limite		WIP
GEO0000000134	Roulement		WIP
CTX0000000064	Assemblage pièces...		WIP
FCT0000000038	Condition de foncti...		WIP
PRC00000192	Pre-processing	Stabilisé Normal Lvl ...	WIP
RES0000000210	Résultat/Résultat		WIP
PRC00000193	Post-processing		WIP
RES0000000211	Résultat/Résultat		WIP



# CERBER solution includes automation of server simulations and integration of client tools

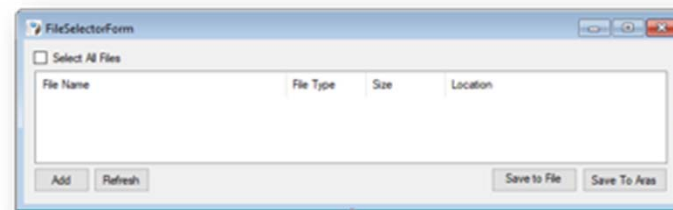
- Simulation tools are managed by the data administrator:
  - Server: Launched from the ARAS Server using the Conversion Server
  - Client: Launched on the local client using direct WebSocket connection using Python

Properties

Tool

Created By: Innovator Admin  
Created On: 2/5/2019  
Modified By: Innovator Admin  
Modified On: 6/9/2019  
Locked By:  
Major Rev: A  
Generation: 1  
State:

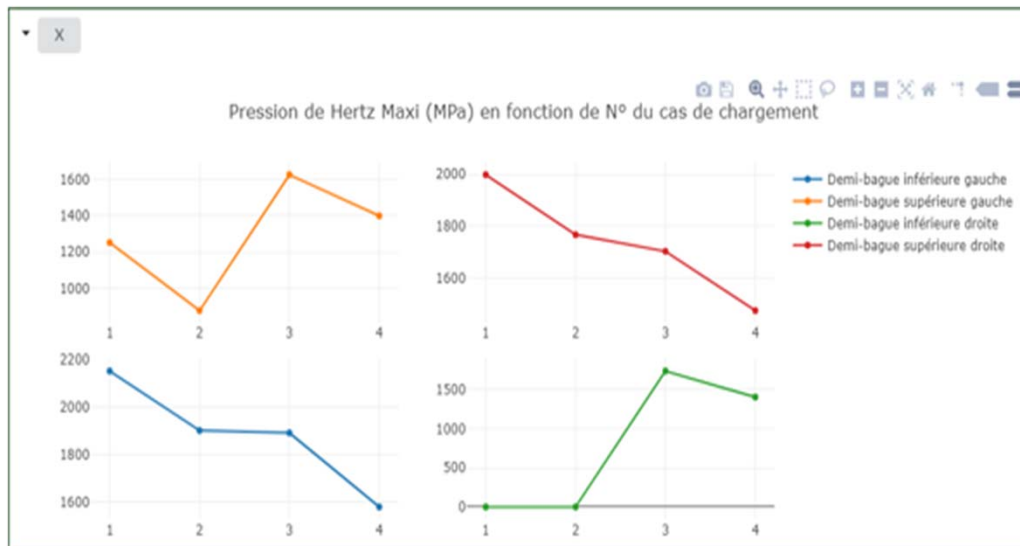
Description	Version	Sequence	Launch Mode	Process Type	Client Tool URL	Tool
PostBB20 1.01	1.01	3	Manual	Post-processing		BB20
InputBB20 1.01	1.01	1	Server	Pre-processing		BB20
BB20 1.01	1.01	2	Server	Processing		BB20
PostDynar 1.01	1.01	3	Manual	Post-processing		Dynar
Dynar 1.01	1.01	2	Server	Processing		Dynar
InputDynar 1.01	1.01	1	Server	Pre-processing		Dynar
FEA-Post-Process	1.0	2	Client	Post-processing	ws://localhost:8901	FEA
WB / SAMCEF	19	1	Client	Processing	ws://localhost:8901	FEA
ANSYS2	19	3	Client	Processing	ws://localhost:8901	FEA2
SAMCEF	1	2	Server	Processing		FEA2
WB / SAMCEF	19	1	Client	Pre-processing	ws://localhost:8901	SAVE
Calcul Puissance Dissipee	1.0	1	Client	Processing	ws://localhost:8901	calcul_puissance...
Estimation du Jeu	1.0	2	Client	Processing	ws://localhost:8901	calcul_puissance...





# CERBER Solution provides simulation reporting & resulting data analytics

- The simulation results can be analyzed using Plotly
- Report can be made on a Study using JSReport



**Study report : E0000050 (12/3/2018)**

Date Etude: 2018-11-10T19:50:06  
Type Etude: Etude de certification CAD  
Objectif : Evaluer des limites de fonctionnement  
Position: Palier 2  
Moteur: DJANGO  
Type Roulement: Value 2  
Tool Chain: PuisseanceDissipee

Input Items		ID	Status
Roulement		GI0000000028	WIP
Condition de fonctionnement		FC0000000174	WIP

#	Type	Process	Type	Process	Type	Process
#1	Pre-processing	PRC0000209	Processing	PRC0000210	Post-processing	PRC0000211

**Conditions:**

- Operating Condition: Cartographique (4 lignes)
- 3-Sigma: True
- Temperature: 100
- Parametres don: [http://sac-integ1.westeurope.cloudapp.azure.com/OSPD/Modt/vault/vaultserver.aspx?dbName=OSPD/Modt&fileId=FF6D7D7F201A483FA819D4929D18BA9&fileName=parametres\\_don&vaultId=67BBB9204FE84A8981ED8313049BA06C](http://sac-integ1.westeurope.cloudapp.azure.com/OSPD/Modt/vault/vaultserver.aspx?dbName=OSPD/Modt&fileId=FF6D7D7F201A483FA819D4929D18BA9&fileName=parametres_don&vaultId=67BBB9204FE84A8981ED8313049BA06C)

**Results:**

- Pressure: 2149
- Ellipsis Out Of Shoulder: 2.282
- Ellipsis out of oil groove: 0.701775
- Results res: [http://sac-integ1.westeurope.cloudapp.azure.com/OSPD/Modt/vault/vaultserver.aspx?dbName=OSPD/Modt&fileId=67AB25121CED4107A47ED2C1D35E36EAA&fileName=results\\_res&vaultId=67BBB9204FE84A8981ED8313049BA06C](http://sac-integ1.westeurope.cloudapp.azure.com/OSPD/Modt/vault/vaultserver.aspx?dbName=OSPD/Modt&fileId=67AB25121CED4107A47ED2C1D35E36EAA&fileName=results_res&vaultId=67BBB9204FE84A8981ED8313049BA06C)



# Q&A