

# Use of S5000F for exchanging NH90 maintenance data

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## Agenda

1. Presentation of NH90 program
2. Why to get feedback data from NH90 fleet
3. Proof of Concept for NH90 Maintenance data
4. Return of experience
5. Next steps

## Helicopter NH90

- NH90 helicopter is a modern 10 tons helicopter for troop transportation (TTH) or Navy operations (NFH).
- NH90 has a carbon fiber fuselage with two sliding doors and rear ramp, composite rotor blades, modular avionic system integrated in a full glass cockpit, fly-by-wire controls with 4-axis autopilot and advanced mission flight aids, specific mission and role-fitted equipment.
- On-board monitoring and diagnostic system monitors NH90 usage and technical events. After flight this data is downloaded in a ground station. Most of the time this ground station is interfaced with Nation's Maintenance information system (MIS). This architecture allows an access to a large amount of detailed data about H/C
- Since its design phase in 1992, NH90 serviceability was a primary objective. It was ensured by applying Integrated Logistic Support activities based on specifications : Mil-STD-1388 for Logistic Support Analysis , S1000D for Technical Publication and S2000M for Material Support
- 14 Nations have ordered 535 NH90 helicopters. As of today 365 are in service and totalize more than 180000 flight hours.



## Agenda

1. Presentation of NH90 program
- 2. Why to get feedback data from NH90 fleet**
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## Requirement to get feedback from Helicopter fleet

- Within ILS activities, NHIndustries has to collect data about maintenance which is done on NH90 fleet in order to improve NH90 serviceability.
- To organize this data collection, Nhindustries publishes pdf forms (unscheduled maintenance, scheduled maintenance, maintenance man-hours per flight hour and engine maintenance)
- Operators get these forms on ePortal, periodically fill them with data and post them back on ePortal. This information is automatically stored in a NH90 maturity database. This data is used by design office to improve NH90.

But growing number of in-service NH90, lack of integration with National Maintenance Information system is creating a real burden on Customer side (workload to manually fill forms, data inaccuracy, missing data, ...).



Directly collect this data from Nation's Maintenance Information System (MIS)

... but we'll have to interface with at least 14 Maintenance Information System !



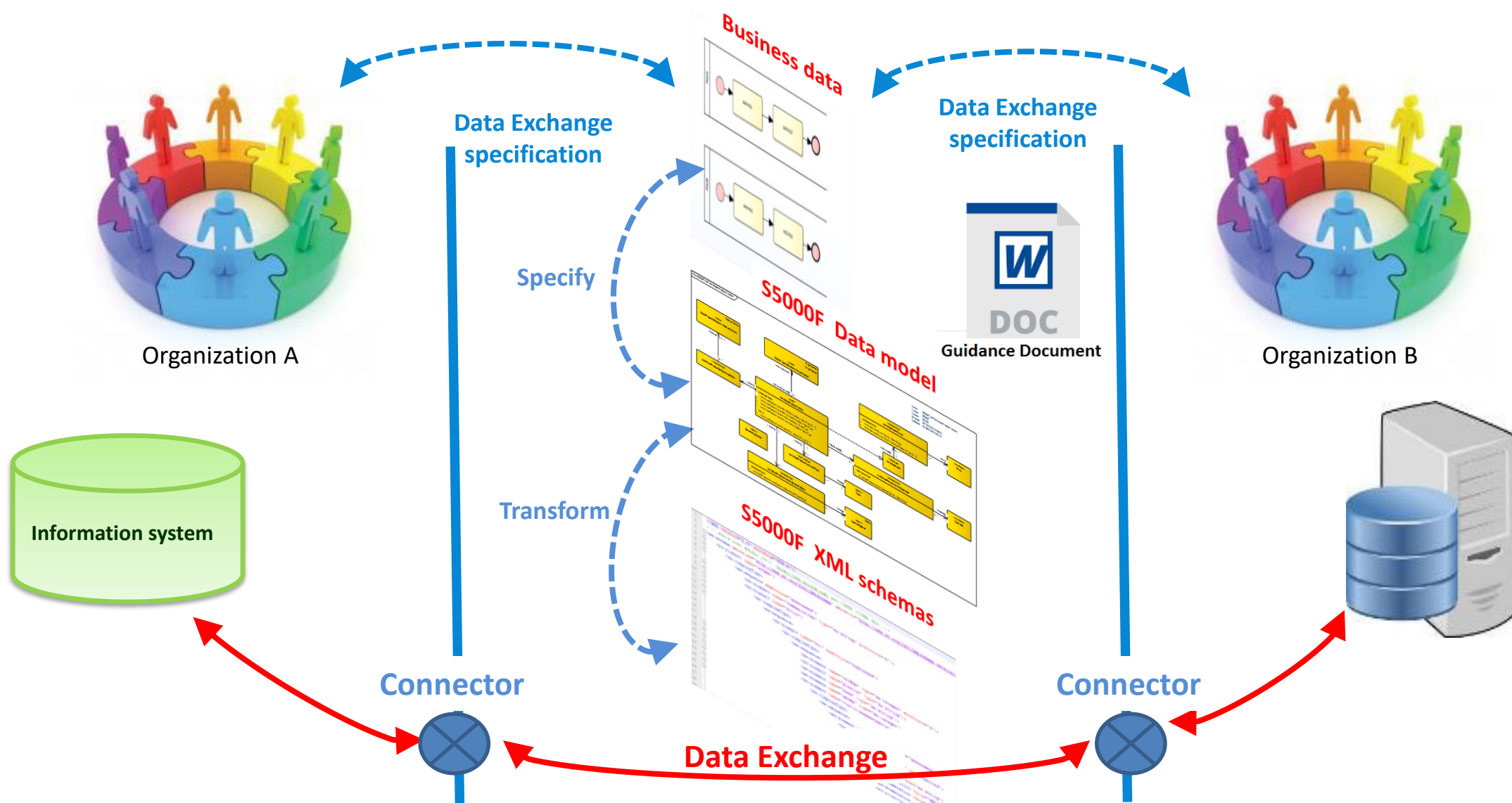
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## Proof of Concept

- Feasibility study to answer the question  
Is S5000F able to get data from Maintenance information System ?
- Analyze of 230 information from French Navy MIS (ATAMS) and French Army MIS (Envision RUSADA) gives following results
  - around 93% information successfully mapped onto S5000F Issue 1. Information not found in S5000F exists in other ASD specification.
  - nearly 70% of mapping rule have a simple (one to one) or medium complexity
- In 2017, decision to develop a proof of concept
  - with limited scope only data necessary for unscheduled maintenance analysis
  - for all French NH90 fleet (MIS ATAMS for Navy H/C and MIS RUSADA for Army H/C)

# Process for implementing S5000F



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# POC - Step 1 : Business analysis for Unscheduled Removal

- To identify POC business process for unscheduled removal, we have analyzed the pdf form (see below) which is contractually agreed to exchange data.

## WEEKLY REPORT ON UNSCHEDULED REMOVALS

Report reference: [MMI\\_U\\_FR\\_01252\\_2016-01-18\\_W03\\_20160225-105256](#)

**FRANCE**

Customer reference:  First date of the reporting week:  Week:

Operator:  Maintainer:  Operating Base:

CHECK & SAVE

Submittal date  
25/03/2016

sec:   
pic:   
date:

No unscheduled removals observed during the reporting week

HELICOPTER DATA				MISSION DATA				REMOVED PART DATA																			
HC	Regt	T12N PM	T12N SP	Operating Environmental Conditions	Operating Temp. Conditions	Mission Phase	Mission Type	Aborted Mission?	Delayed ? Time?	P/N	S/N	Qty	Item Name	T12N PM	T12N SP	T12N PM	CSM GROUP	CSO STRUCT	CSM STRUCT	Date of Failure	Failure Code	Failure Description	Action Taken	SM or UM	SM Type	Remarks	
-	1309 / 57R014	F-MEAN	210.43	475	Sand/And/Or Dust-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	NO	NO	SE23A933201	NA	1	HUB SIDE GUIDE BUSH							20/01/2016	Leakage	LEAKAGE	Replaced-Scrapped	SM	IS IN	
-	1309 / 57R014	F-MEAN	210.43	475	Sand/And/Or Dust-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	NO	NO	AN4040	NA	1	COUPLING W/AF. CLIPK DISCONNECT							19/01/2016	Leakage	LEAKAGE	Replaced-Scrapped	SM	IS IN	
-	1309 / 57R014	F-MEAN	210.43	475	Sand/And/Or Dust-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	NO	NO	DN4165214F4	NA	1	BACKSHELL							19/01/2016	Broken	HEAD SCREEN BROKEN	Replaced-Scrapped	SM	IS IN	

Form Version 1.86
UM Form - Form ID: 01252 - Doc ID: - Doc Index:
Page 1 of 1

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# Analysis of Unscheduled Removal form (1/5)

**WEEKLY REPORT ON UNSCHEDULED REMOVALS**

Report reference: MMI\_U\_FR\_01252\_2016-01-18\_W03\_20160225-105256

**FRANCE** Customer reference: [ ] First date of the reporting week: 18/01/2016 (Monday) Week: 03 / 2016

Operator: 1° RHC ALAT French Army Maintainer: 1° RHC ALAT French Army Operating Base: Phalsbourg

No unscheduled removals observed during the reporting week

HELICOPTER DATA				MISSION DATA				REMOVED PART DATA																					
HC	Regt	TTM hr	TLN hr	Operating Environmental Conditions	Operating Temp. Conditions	Mission Phase	Mission Type	Aborted Mission?	Delayed > 15min?	P/N	SN	Qty	Item Name	TSR hr	TSD hr	TSR hr	CSM hr	CSO hr	CSR hr	Date of Failure	Failure Code	Failure Description	Action Taken	SM or LM	SM Type	Remarks			
-	1309 / 13RA014	-	F-MEAN	210.42	473	Sand And/Ov Dual-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	-	NO	NO	2622A042301	NA	1	HUB SIDE GUDGE BUSH						20/11/2016	Leakage	LEAKAGE	Replaced-Scrapped	-	SM	IS PH	
-	1309 / 13RA014	-	F-MEAN	210.42	473	Sand And/Ov Dual-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	-	NO	NO	AB46A0	NA	1	COUPLING HALF, QUICK DISCONNECT						19/11/2016	Leakage	LEAKAGE	Replaced-Scrapped	-	SM	IS PH	
-	1309 / 13RA014	-	F-MEAN	210.42	473	Sand And/Ov Dual-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	-	NO	NO	0491027494	NA	1	BACKSHILL						19/11/2016	Broken	HEAD SCREW BROKEN	Replaced-Scrapped	-	SM	IS PH	

Report reference: MMI\_U\_FR\_01252\_2016-01-18\_W03\_20160225-105256

**FRANCE** Customer reference: [ ] First date of the reporting week: 18/01/2016 (Monday) Week: 03 / 2016

Operator: 1° RHC ALAT French Army Maintainer: 1° RHC ALAT French Army Operating Base: Phalsbourg

No unscheduled removals observed during the reporting week

Organization + Envelope data

Parties

Envelope

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# Analysis of Unscheduled Removal form (2/5)

**WEEKLY REPORT ON UNSCHEDULED REMOVALS**

Report reference: MML\_U\_FR\_01252\_2016-01-18\_W03\_20160225-105256

**FRANCE** Customer reference: [ ] First date of the reporting week: 18/01/2016 (Monday) Week: 03 / 2016

Operator: RHC ALAT French Army Maintainer: RHC ALAT French Army Operating Base: Phalsbourg

No unscheduled removals observed during the reporting week

HELICOPTER DATA				MISSION DATA				REMOVED PART DATA																				
H/C	Reg#	TTSN (FH)	TLSN (LD)	Operating Environmental Conditions		Operating Temp. Conditions	Mission Phase	Mission Type	Aborted Mission?	Delayed > 15min?	P/N	SN	Qty	Item Name	TSN (FH)	TSD (LD)	TSR (FH)	CSM (LD)	CSD (LD)	CSR (LD)	Date of Failure	Failure Code	Failure Description	Action Taken	SM or LHM	SM Type	Remarks	
-	1309 / TFRA014	F-MEAN	210.43	473	Sand And/Or Dust-Laden Atmosphere		Between +20°C And +40°C	Maintenance	Maintenance	NO	NO	2622A042301	NA	1	HUB SIDE GUDGE BUSH							20/01/2016	Leakage	LEAKAGE	Replaced-Scrapped	SM	IS FH	
-	1309 / TFRA014	F-MEAN	210.43	473	Sand And/Or Dust-Laden Atmosphere		Between +20°C And +40°C	Maintenance	Maintenance	NO	NO	AB46A0	NA	1	COUPLING HALF, QUICK DISCONNECT							19/01/2016	Leakage	LEAKAGE	Replaced-Scrapped	SM	IS FH	
-	1309 / TFRA014	F-MEAN	210.43	473	Sand And/Or Dust-Laden Atmosphere		Between +20°C And +40°C	Maintenance	Maintenance	NO	NO	0H4162/HF4	NA	1	BACKSHELL							19/01/2016	Broken	HEAD SCREW BROKEN	Replaced-Scrapped	SM	IS FH	

Form Version 1.05

HELICOPTER DATA				MISSION DATA					
H/C	Reg#	TTSN (FH)	TLSN (LD)	Operating Environmental Conditions		Operating Temp. Conditions	Mission Phase	Mission Type	
-	1309 / TFRA014	F-MEAN	210.43	473	Sand And/Or Dust-Laden Atmosphere		Between +20°C And +40°C	Maintenance	Maintenance
-	1309 / TFRA014	F-MEAN	210.43	473	Sand And/Or Dust-Laden Atmosphere		Between +20°C And +40°C	Maintenance	Maintenance
-	1309 / TFRA014	F-MEAN	210.43	473	Sand And/Or Dust-Laden Atmosphere		Between +20°C And +40°C	Maintenance	Maintenance

**Aircraft**

*Aircraft +Operating counters*

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# Analysis of Unscheduled Removal form (3/5)

**WEEKLY REPORT ON UNSCHEDULED REMOVALS**

Report reference: MML\_U\_FR\_01252\_2016-01-18\_W03\_20160225-105256

**FRANCE** Customer reference: [ ] First date of the reporting week: 18/01/2016 (Monday) Week: 03 / 2016

Operator: RHC ALAT French Army Maintainer: RHC ALAT French Army Operating Base: Phalsbourg

No unscheduled removals observed during the reporting week

HELICOPTER DATA				MISSION DATA				REMOVED PART DATA																			
HC	Reg#	TTSN (FH)	TLSN (LD)	Operating Environmental Conditions	Operating Temp. Conditions	Mission Phase	Mission Type	Aborted Mission?	Delayed > 15min?	P/N	SN	Qty	Item Name	TSM (M)	TSD (M)	TSR (M)	CSM (M)	CSO (M)	CSR (M)	Date of Failure	Failure Code	Failure Description	Action Taken	SM or LM	SM Type	Remarks	
1309 / TFRA014	F-MEAN	210.43	473	Sand And/Or Dust-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	NO	NO	5627A032301	NA	1	HUB SIDE GUDGE BUSH								20/01/2016	Leakage	LEAKAGE	Replaced-Scrapped	SM	IS FH	
1309 / TFRA014	F-MEAN	210.43	473	Sand And/Or Dust-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	NO	NO	AB46A0	NA	1	COUPLING HALF, QUICK DISCONNECT								19/01/2016	Leakage	LEAKAGE	Replaced-Scrapped	SM	IS FH	
1309 / TFRA014	F-MEAN	210.43	473	Sand And/Or Dust-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	NO	NO	0W45E7H04	NA	1	BACKSHILL								19/01/2016	Broken	HEAD SCREW BROKEN	Replaced-Scrapped	SM	IS FH	

HELICOPTER DATA				MISSION DATA					
H/C	Reg#	TTSN (FH)	TLSN (LD)	Operating Environmental Conditions	Operating Temp. Conditions	Mission Phase	Mission Type	Aborted Mission?	Delayed > 15min?
1309 / TFRA014	F-MEAN	210.43	473	Sand And/Or Dust-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	NO	NO
1309 / TFRA014	F-MEAN	210.43	473	Sand And/Or Dust-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	NO	NO
1309 / TFRA014	F-MEAN	210.43	473	Sand And/Or Dust-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	NO	NO

**Flight** *Mission, Environment, Result*

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# Analysis of Unscheduled Removal form (4/5)



## WEEKLY REPORT ON UNSCHEDULED REMOVALS

Report reference: MML\_U\_FR\_01252\_2016-01-18\_W03\_20160225-105256

FRANCE

Customer reference: \_\_\_\_\_ First date of the reporting week: 18/01/2016 (Monday) Week: 03 / 2016

Operator: RHC ALAT French Army Maintainer: RHC ALAT French Army Operating Base: Phalsbourg

CHECK & SAVE

Submitted date: 25/02/2016

Doc. n°: \_\_\_\_\_ Doc. index: \_\_\_\_\_ Doc. date: \_\_\_\_\_

No unscheduled removals observed during the reporting week

HELICOPTER DATA				MISSION DATA		REMOVED PART DATA													Date of Failure		Failure Code		Action Taken		SM or LHM		Remarks	
INC	Regt	TTSN No	TLSN No	Operating Environmental Conditions	Operating Temp. Conditions	Mission Phase	Mission Type	Aborted Mission?	Delayed > 15min?	P/N	S/N	Qty	Item Name	TSN (FH)	TSO (FH)	TSR (FH)	CSN (OPC/LD)	CSO (OPC/LD)	CSR (OPC/LD)	Date of Failure	Failure Code	Failure Description	Action Taken	SM or LHM	SM Type	Remarks		
-	1309 / 16RA014	F-MEAN	210.42	473	Sand And/Ox Dual-Laden Atmosphere	Between -20°C And +40°C	Maintenance	Maintenance	NO	NO	S652A4063201	NA	1	HUB SIDE GUIDE BUSH							20/01/2016	Leakage	LEAKAGE	Replaced-Scrapped	SM	IS FH		
-	1309 / 16RA014	F-MEAN	210.42	473	Sand And/Ox Dual-Laden Atmosphere	Between -20°C And +40°C	Maintenance	Maintenance	NO	NO	A840A10	NA	1	COUPLING HALF, QUICK DISCONNECT								19/01/2016	Leakage	LEAKAGE	Replaced-Scrapped	SM	IS FH	
-	1309 / 16RA014	F-MEAN	210.42	473	Sand And/Ox Dual-Laden Atmosphere	Between -20°C And +40°C	Maintenance	Maintenance	NO	NO	EN4165J14P4	NA	1	BACKSHELL								19/01/2016	Broken	HEAD SCREW BROKEN	Replaced-Scrapped	SM	IS FH	

Form Version 1.06

### REMOVED PART DATA

Aborted Mission?	Delayed > 15min?	P/N	S/N	Qty	Item Name	TSN (FH)	TSO (FH)	TSR (FH)	CSN (OPC/LD)	CSO (OPC/LD)	CSR (OPC/LD)	Date of Failure	Failure Code
NO	NO	S652A4063201	NA	1	HUB SIDE GUIDE BUSH							20/01/2016	Leakage
NO	NO	A840A10	NA	1	COUPLING HALF, QUICK DISCONNECT							19/01/2016	Leakage
NO	NO	EN4165J14P4	NA	1	BACKSHELL							19/01/2016	Broken

Equipment and operating counters

Equipment

# Analysis of Unscheduled Removal form (5/5)

**WEEKLY REPORT ON UNSCHEDULED REMOVALS**

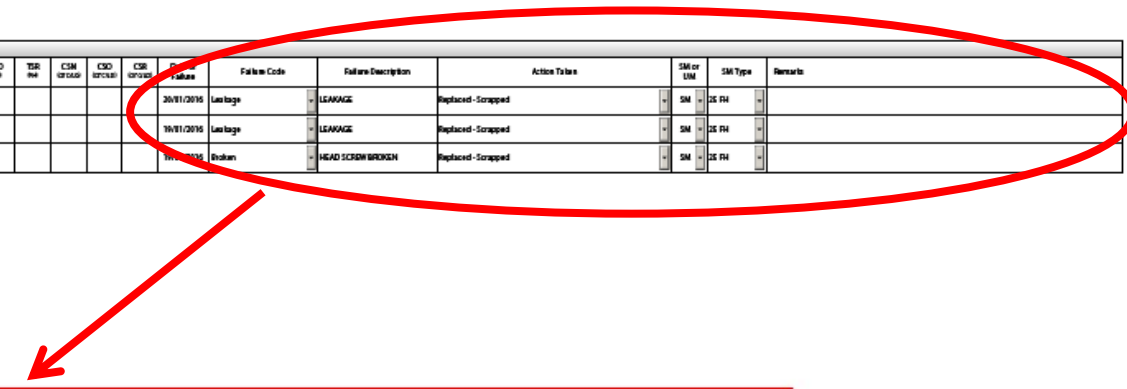
Report reference: MML\_U\_FR\_01252\_2016-01-18\_W03\_20160225-105256

**FRANCE** Customer reference: [ ] First date of the reporting week: 18/01/2016 (Monday) Week: 03 / 2016

Operator: RHC ALAT French Army Maintainer: RHC ALAT French Army Operating Base: Phalsbourg

No unscheduled removals observed during the reporting week

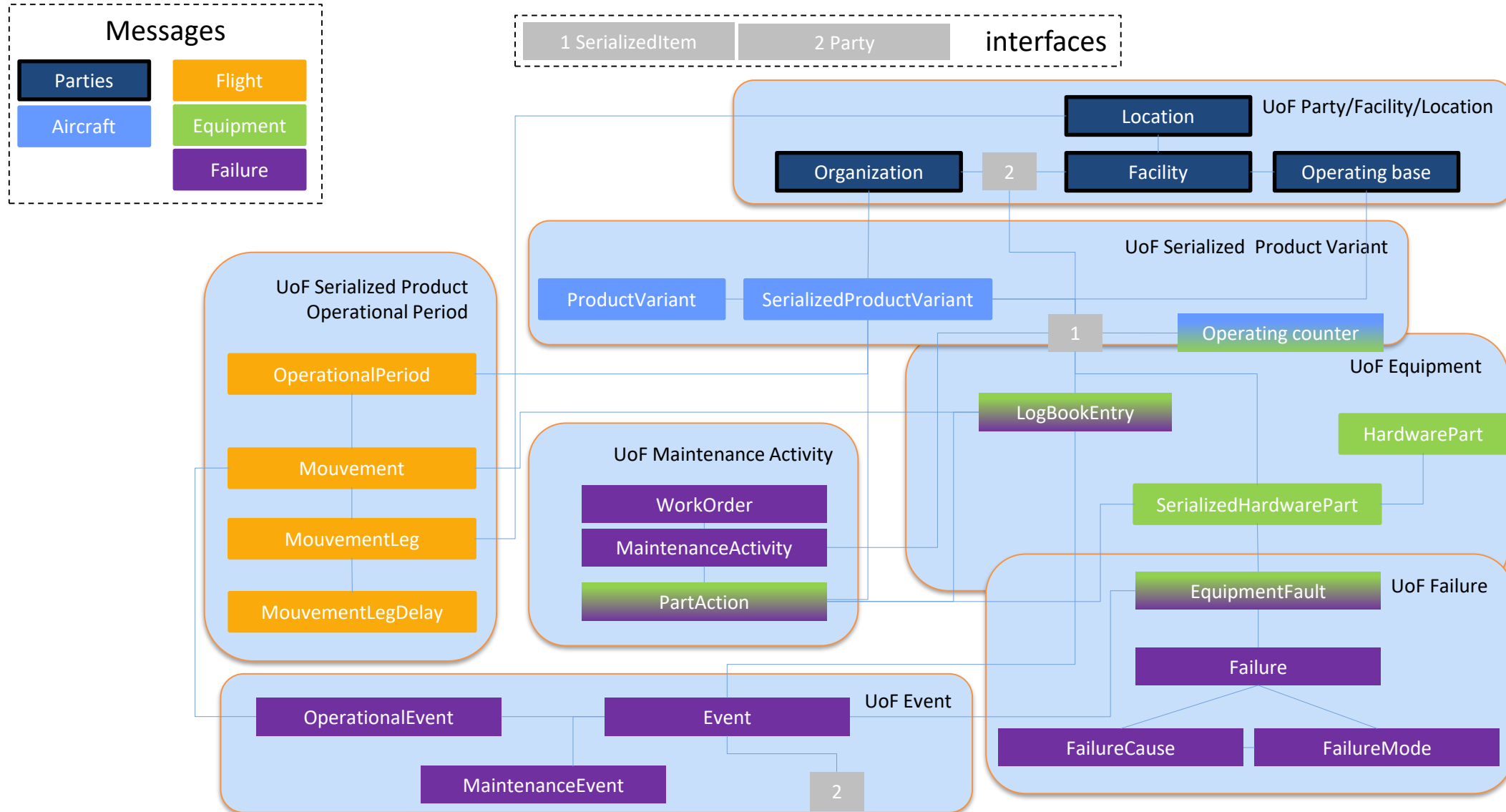
HELICOPTER DATA				MISSION DATA				REMOVED PART DATA																				
HC	Regt	TTM hr	TLN hr	Operating Environmental Conditions		Operating Temp. Conditions	Mission Phase	Mission Type	Aborted Mission?	Delayed > 15min?	P/N	SN	Qty	Item Name	TSR hr	TSD hr	TSR hr	CSM hr	CSO hr	CSR hr	Failure Code	Failure Description	Action Taken	SM or UM	SM Type	Remarks		
-	1309 / 'FRA014	F-MEAN	210.42	473	Sand And/Ov Dual-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	NO	NO	2627A042301	NA	1	HUB SIDE GUDGE BUSH								20/01/2016	Leakage	LEAKAGE	Replaced - Scrapped	SM	25 FH	
-	1309 / 'FRA014	F-MEAN	210.42	473	Sand And/Ov Dual-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	NO	NO	AB4140	NA	1	COUPLING HALF, QUICK DISCONNECT								19/01/2016	Leakage	LEAKAGE	Replaced - Scrapped	SM	25 FH	
-	1309 / 'FRA014	F-MEAN	210.42	473	Sand And/Ov Dual-Laden Atmosphere	Between +20°C And +40°C	Maintenance	Maintenance	NO	NO	0H41027H4	NA	1	BACKSHILL								19/01/2016	Broken	HEAD SCREW BROKEN	Replaced - Scrapped	SM	25 FH	



Failure		Failure and Maintenance Activity							
N (LD)	CSO (OPC/LD)	CSR (OPC/LD)	Date of Failure	Failure Code	Failure Description	Action Taken	SM or UM	SM Type	Remarks
			20/01/2016	Leakage	LEAKAGE	Replaced - Scrapped	SM	25 FH	
			19/01/2016	Leakage	LEAKAGE	Replaced - Scrapped	SM	25 FH	
			19/01/2016	Broken	HEAD SCREW BROKEN	Replaced - Scrapped	SM	25 FH	

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# POC Step 2 : Units of Functionalities, classes and relationships



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## POC – Step 3 : S5000F messages



PARTIES

- Organizations: Maintainer / Operator
- People : Maintainer / Operator
- Adresses

Parties

*Slow-changing information. Message defined but not implemented in POC .*



AIRCRAFT AGING

- Helicopters and Variants
- Operating counters
- « Parties » linked to Helicopter

Aircraft

*Monthly message giving aircrafts' aging at end of month*



AIRCRAFT FLIGHTS

- Operational Period
- Flight list
- Flight data : duration, delay, counters

Flight

*Monthly message with all information about flights done during the month*



EQUIPMENT AGING

- Equipment list
- Log-Book

Equipment

*Monthly message giving Equipment's aging at end of month*



EQUIPMENT REMOVAL

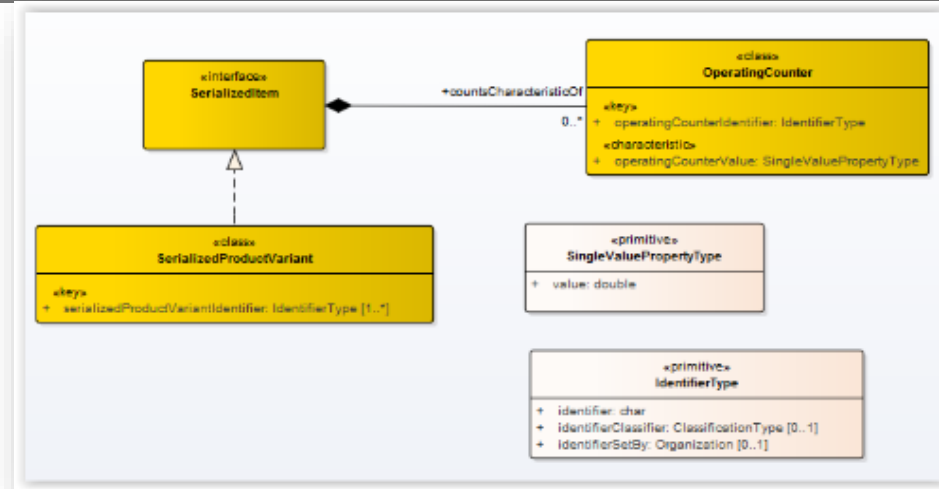
- Unscheduled removal
- Failure description and Failure cause,
- Part Action

Failure

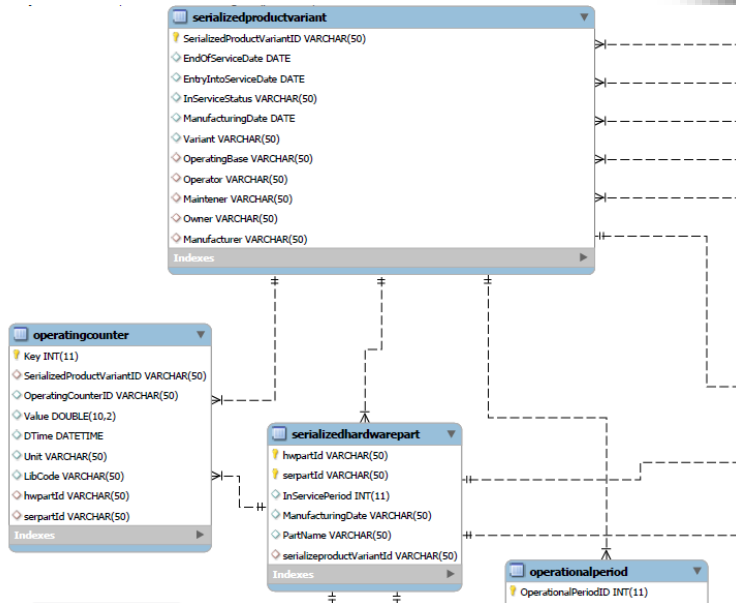
*Monthly message with all information about equipment removal done during the month*



# POC Step 4 : Guidance Document



UoF S5000F(UML in EA) limited to aircraft



SQL Data model S5000F Aircraft

```

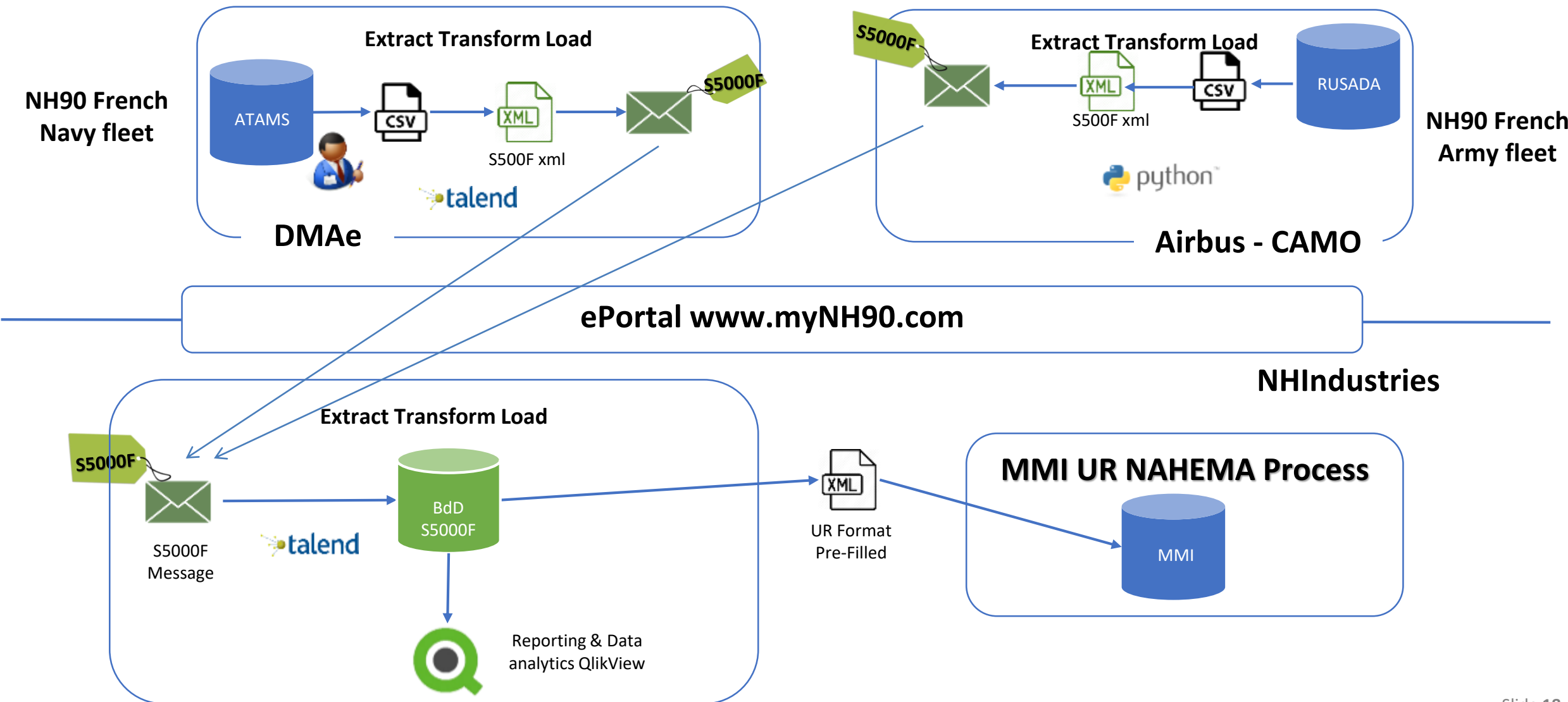
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      <id>1018</id>
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    </serPVID>
    - <sproda>
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          </orgIdId>
        </setBy>
      </prodv>
    </sproda>
  </spv>
</SerializedProductVariants>
  
```

XML S5000F Aircraft

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# POC Step 5 : technical architecture (extractor, S5000F database)

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## POC - Achieved results

- Identification of ‘useful parts’ of S5000F UML model.  
Definition of XML messages and their associated XML schemas  
Guidance document with basic « business rules »
- For documenting and implementing this model, we<sup>(1)</sup> used **Enterprise Architect** (SparxSystems), **ETL** (Open source Talend), **Python** (Open source), **XML Spy** (ALTOVA), **MySQL** (open source) and **Qlik Sense** (Qlik)
- Using this S5000F implementation we<sup>(2)</sup> exchanged and stored in S5000F database:
  - For French Army NH90, all flights from 2014 to 2018 :  
30 Aircrafts, 16 652 flights , 478 PNR, 2268 SN and 2892 Failure
  - For French Navy NH90, flights done in 2014 :  
20 Aircrafts, 1336 flights , 117 PNR, 565 SN and 253 Failure

<sup>(1)</sup> Thanks to CIMPA and Cap Gemini project team

<sup>(2)</sup> Thanks to French DMAé and DGA

## Agenda

1. Presentation of NH90 program
2. Why to get feedback data from NH90 fleet
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5. Next steps

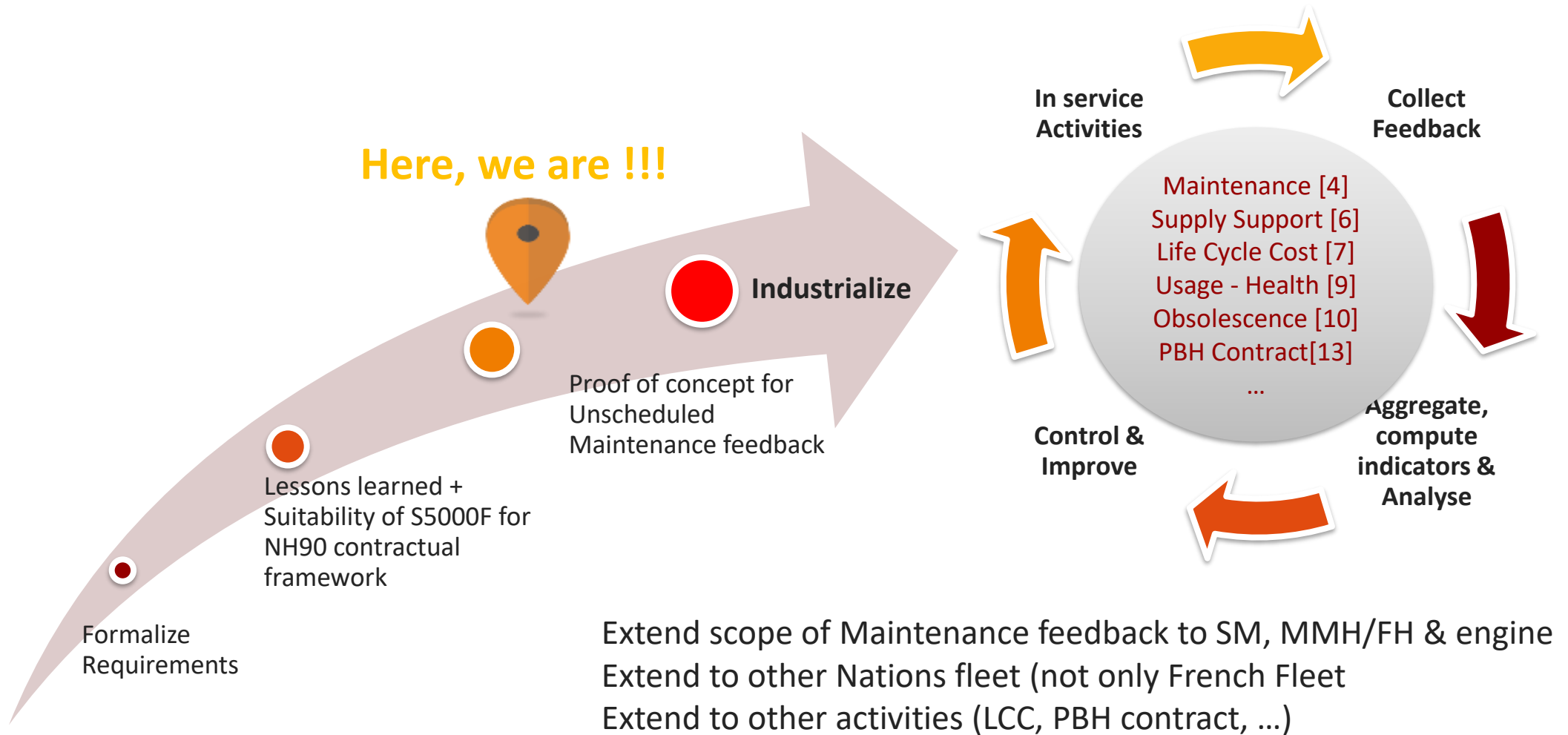
## Lesson learned

- S5000F ULM model and S5000F XSD allow to design data exchange compliant with S5000F specification.
  - S5000F data model allows to ensure data persistence.
  - S5000F xsd 1.0 is mandatory to validate S5000F new implementation.
- NHIndustries POC shows that IT workload and elapsed project time are acceptable. Another implementation may precise this workload .
- Similar description (UML schema and XSD) for the others S-series specifications would improve numeric continuity.
- With this use case (Unscheduled Removal), we collect many data that can be used for various goals (other functional domains)
- As S5000F does not define messages, it is convenient to create messages using best practices for instance 'Aircraft Aging' allows a periodic synchronization of 'Aircraft Flight'

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## NEXT STEPS ...



**Thank you**  
for your attention!

**Questions?**