DEFENCE AND SPACE

MRTT Service Life Extension Program (SLEP)

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Javier Gomez-Escalonilla (Engineering, Fatigue & Damage Tolerance)

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AIRBUS

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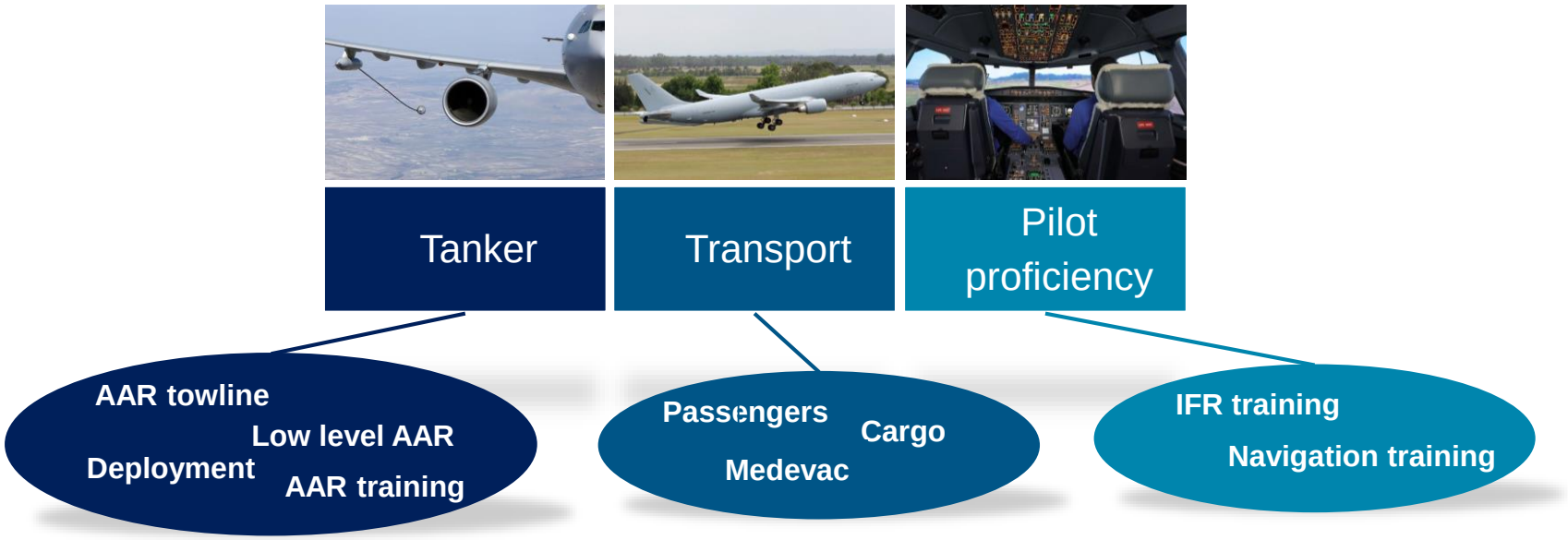
Introduction

MRTT SLEP context

The A330-MRTT is a multipurpose strategic aircraft with three main in-service roles: **tanker, transport and pilot proficiency**. These main roles are divided into a number of typical different missions.



The relevance of each of these roles and the types of missions in each fleet depends on the strategic scenario of each nation and is therefore defined by each Air Force during the acquisition phase. This definition is included in the so-called '**Statement of Operating Intent**', which is used by Airbus engineers as the starting point to elaborate a tailored maintenance program aimed to keep the highest safety standard while minimizing the cost of ownership.

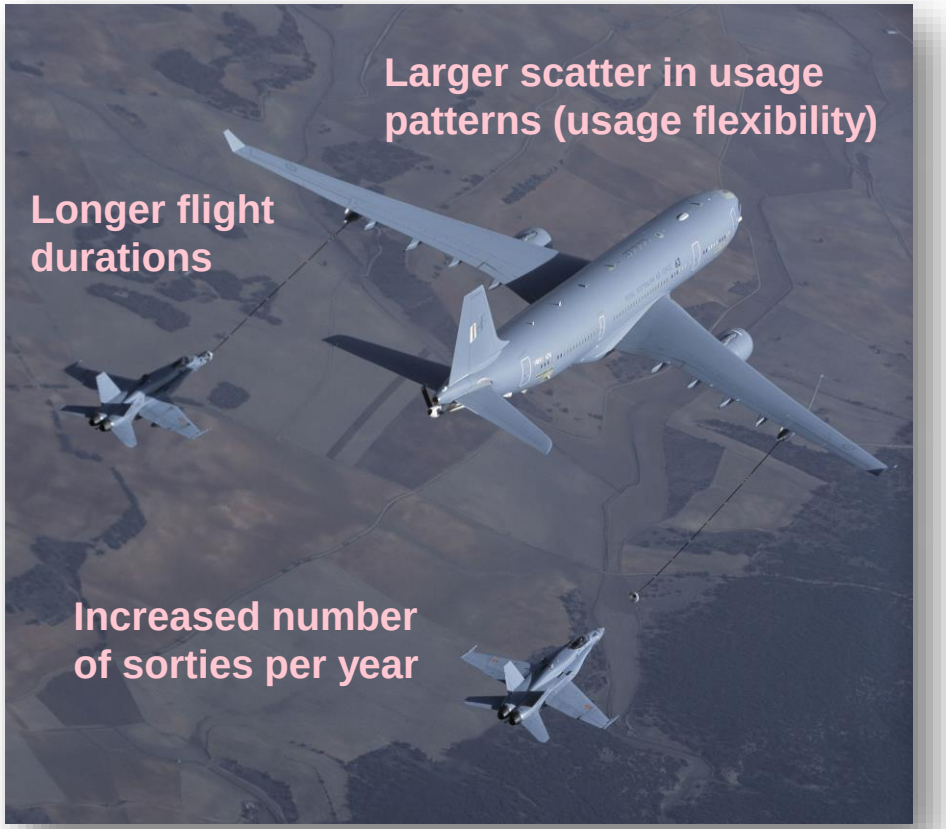
MRTT SLEP context

Once in-service, the usage of each individual tail number is tracked using the information from the **monitoring systems** installed in the aircraft. The representativeness of the maintenance program is evaluated with each evolution of the usage patterns.

Since the entry into service of the first MRTTs it has been evident that the initial usage projections made by the Air Forces were somewhat pessimistic.

Almost of all the nations are accomplishing much **more sorties per year** than predicted. The **variety of missions** is also much larger than expected, with a wide range of transport and, particularly, AAR types of flights. Of special relevance is the **very intensive use of the Boom** with a large increase in the number of contacts per year.

Higher usage severity



Significantly higher in number of refuelling operations with Boom

MRTT SLEP context

Considering this scenario, Airbus DS launched the **MRTT Service Life Assessment Program** (SLAP) initiative in 2015 to analyse the feasibility of a life extension and to develop the main technical technologies that would be needed. The outcomes were presented in successive **Airbus MRTT Users Group** (AMUG) Conferences and working groups.

- A330 platform capability assessment
- Impact of A330-MRTT usage
- A330-MRTT SLEP feasibility

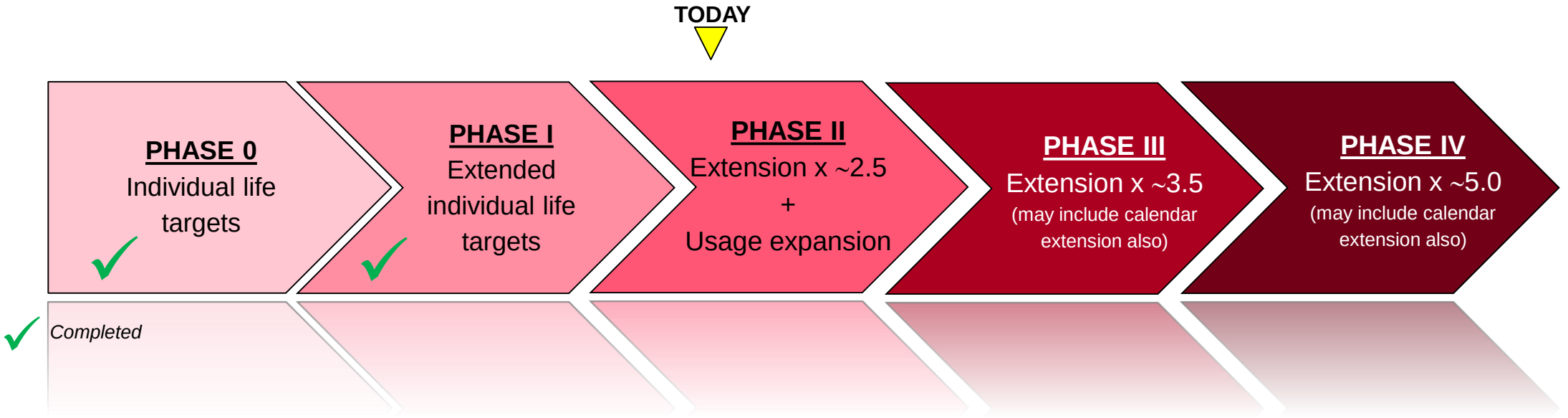
- Usage flexibility definition
- Initial SLEP methodology
- Maintenance program arrangement

- Consolidated SLEP principles
- Consolidated SLEP strategy

- Technical details
- Certification approach
- Roadmap and schedule

MRTT SLEP context

As a result of this work, a Service Life Extension Program (SLEP) roadmap has been established, divided into **four phases** conceived to get from the MRTT fleet the maximum life potential of the platform, taking into account the applicable military specifities.



The phases will be **launched sequentially** throughout the lifecycle of the MRTT platform, depending on the needs of the different Air Forces. Phase I of this plan has already been completed, and phase II is currently ongoing.

MRTT SLEP context

Overall, the four phases can increase the life of the aircraft up to **five times the initial requirement** in terms of flights/flight hours. Phases III and IV include also the possibility of extensions in calendar time up **to two times the initial requirement**.

At the same time, during phase II the maintenance program will be expended in order to consider **multiple usage patterns** (usage adaptation).

Therefore, the engineering activities conducted by Airbus DS in the frame of the SLEP are split in two main groups:

- Activities aimed to extend the life of the aircraft and its systems/subsystems
- Activities focused on providing higher usage flexibility in the maintenance program

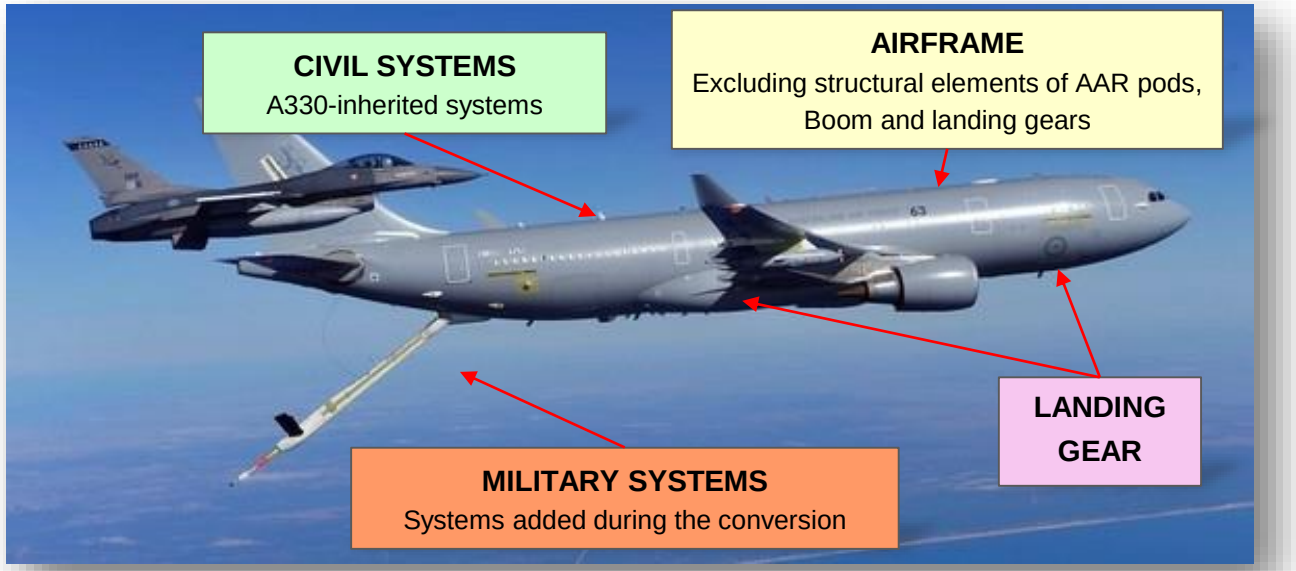
MRTT SLEP life extension activities

MRTT SLEP life extension activities

The life extension assessment of the aircraft has been divided into **four major blocks**: airframe, civil systems, landing gear and military systems.

Aspects studied:

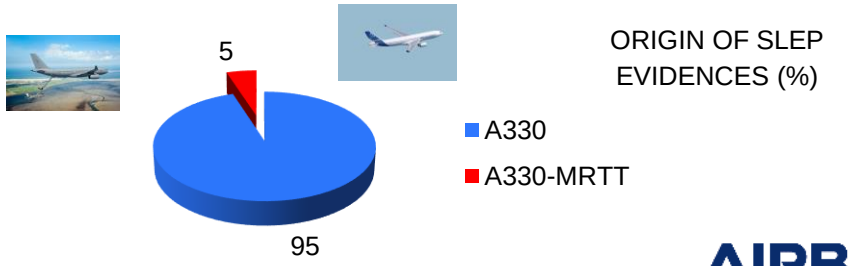
- Sensitivity of each source of damage (airframe), element (landing gear) or system/subsystem (civil and military systems) to the military usage of the aircraft
- Current maintenance practices
- Current and expected number of life-limited parts
- Need of dedicated modifications or replacements to achieve the SLEP targets
- Nature and origin of the engineering evidences (tests, analyses) needed to obtain the certification from the airworthiness authorities



MRTT SLEP life extension activities

Landing gears scenario:

ITEM	USAGE SENSITIVITY	MAINTENANCE	REPLACEMENTS/ MODIFICATIONS	ST
NLG	Impact of military usage evaluated	Current overhaul periodicity and procedures validated for SLEP purposes	Number of life-limited safety critical elements will remain constant despite life extension. Life improvements to be achieved using A330 data	
MLG	Impact of military usage evaluated	Current overhaul periodicity and procedures validated for SLEP purposes	Number of life-limited safety critical elements will remain constant despite life extension. Life improvements to be achieved using A330 data	



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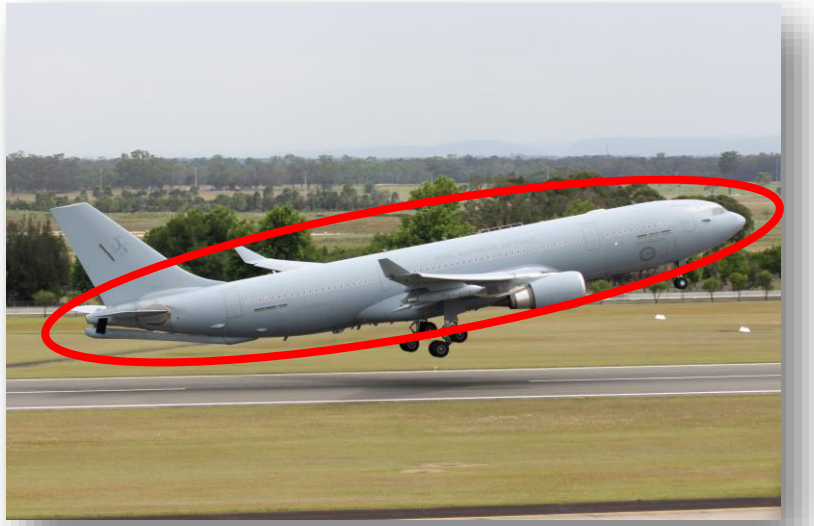
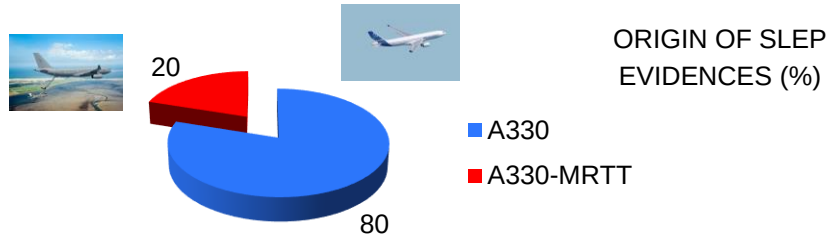
MRTT SLEP life extension activities

Airframe scenario:

ITEM	USAGE SENSIT	MAINTENANCE	REPLACEMENTS/ MODIFICATIONS	ST
Local Fatigue Damage	Impact of military usage evaluated	Current inspection procedures validated for SLEP purposes. Periodicities will depend on usage	No dedicated replacements/ modifications needed to achieve SLEP targets	
Widespread Fatigue Damage	Impact of military usage evaluated	Current inspection procedures validated for SLEP purposes. Periodicities will depend on usage	No changes with respect to A330	
Accidental Damage	Impact of military usage evaluated	Current inspection procedures validated for SLEP purposes. Periodicities will depend on usage	No dedicated replacements/ modifications needed to achieve SLEP targets	
Environmntl Damage	Impact of military usage evaluated	Current inspection procedures validated for SLEP purposes	No dedicated replacements/ modifications needed to achieve SLEP targets	





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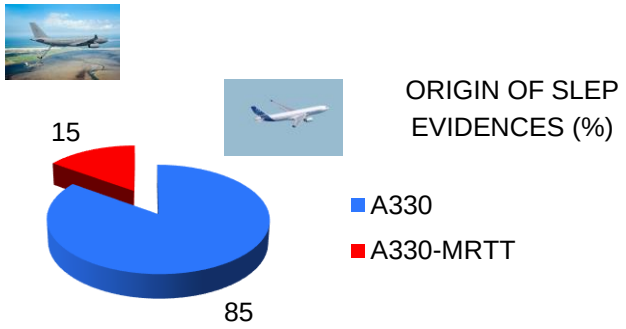
MRTT SLEP life extension activities

Civil systems scenario:

ITEM	USAGE SENSIT	MAINTENANCE	REPLACEMENTS/ MODIFICATIONS	
Air conditioning & pressurization	Impact of military usage evaluated	Current inspection procedures validated for SLEP purposes. Periodicities will depend on usage	Number of life-limited safety critical elements (if any) will remain constant despite life extension. Life improvements to be achieved using A330 data	
Electrical power	Impact of military usage evaluated			
Fire protection	Impact of military usage evaluated			
Flight control	Impact of military usage evaluated			
Fuel	Impact of military usage evaluated			
Hydraulic	Impact of military usage evaluated			
Oxygen	Impact of military usage evaluated			
Information systems	Impact of military usage evaluated			



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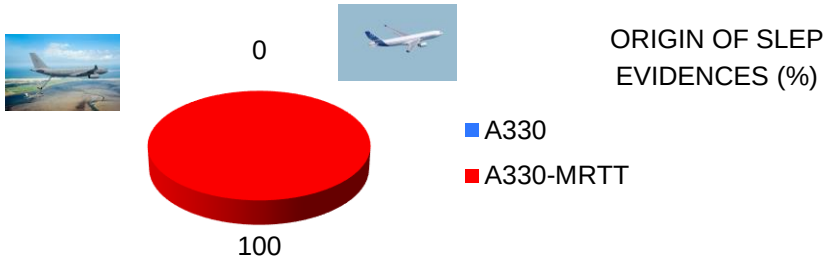
MRTT SLEP life extension activities

Military systems scenario:

ITEM	USAGE SENSIT	MAINTENANCE	REPLACEMENTS/ MODIFICATIONS	ST
IFR/AAR fuel system	Yes	Current inspection procedures validated for SLEP purposes. Periodicities will depend on usage	Number of life-limited safety critical elements (if any) will be evaluated by dedicated testing	
AAR pod	Yes	Current inspection procedures validated for SLEP purposes. Periodicities will depend on usage	Number of life-limited safety critical elements (if any) will remain constant	
Boom	Yes	Current inspection procedures will be improved to exploit higher project maturity. Periodicities will depend on usage	Number of life-limited safety critical elements (if any) will be evaluated by dedicated testing	

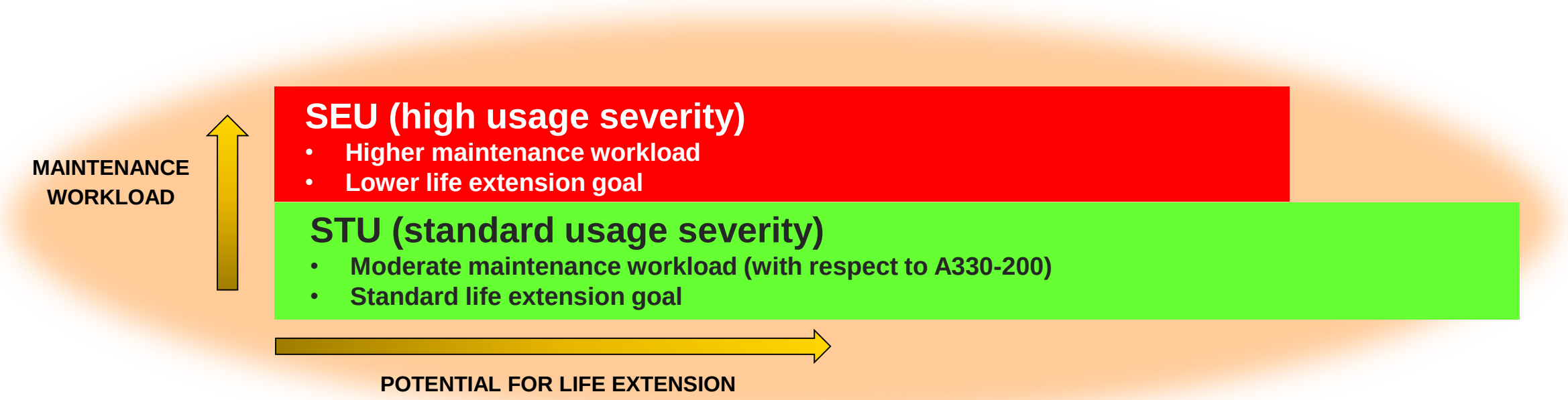


MRTT SLEP usage flexibility activities

MRTT SLEP usage flexibility activities

Regarding usage flexibility, since phase II the SLEP is based on two ‘usage regions’ for the whole MRTT fleet: **Standard Usage (STU)** and **Severe Usage (SEU)**. Thus, the previous arrangement of phases 0 and I (‘one operator – one usage’) disappears and a new concept of ‘aircraft allocation’ appears.

Both STU and SEU maintenance programs have different associated workloads and specific potential for life extension.



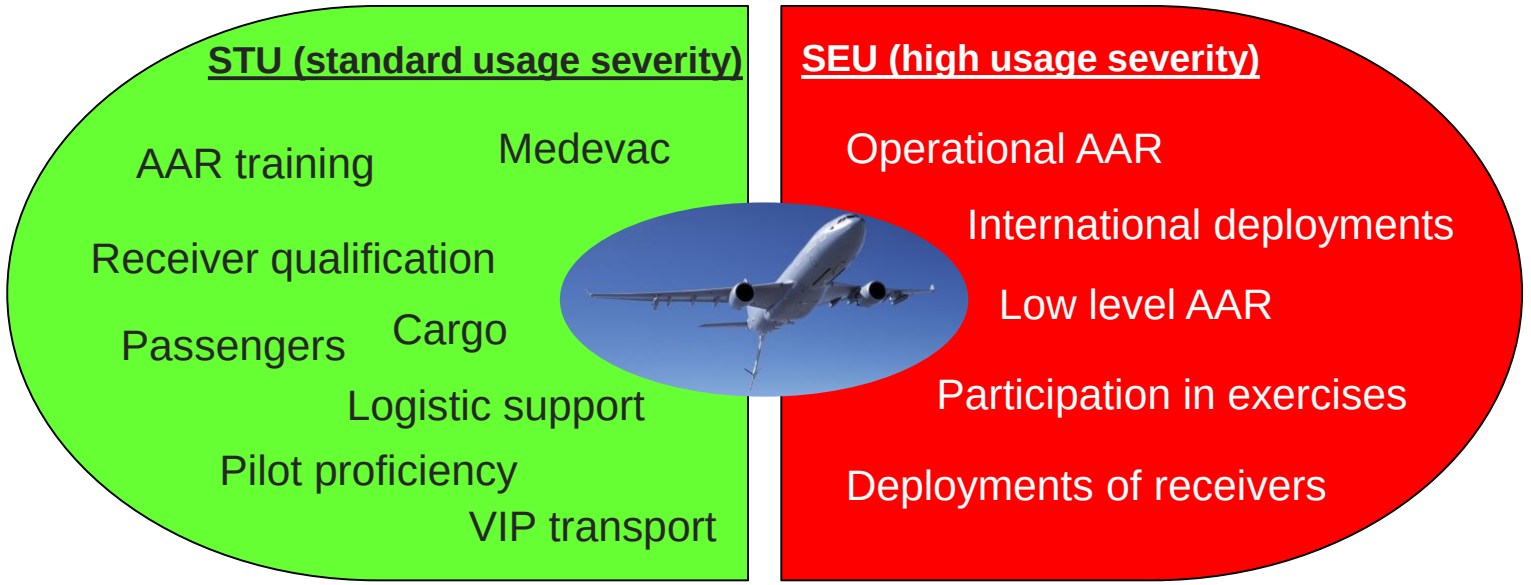
MRTT SLEP usage flexibility activities

STU has been conceived to represent the **normal peacetime usage**, in which is possible to avoid high severity operation by implementing some standard preservation actions. On the other side, SEU corresponds to a continued **conflict or conflict-like usage**, in which operational needs have full priority over preservation actions.

PEACETIME

SCHEDULED OPERATIONS

PLATFORM PRESERVATION PRACTICES FEASIBLE AND ENFORCED



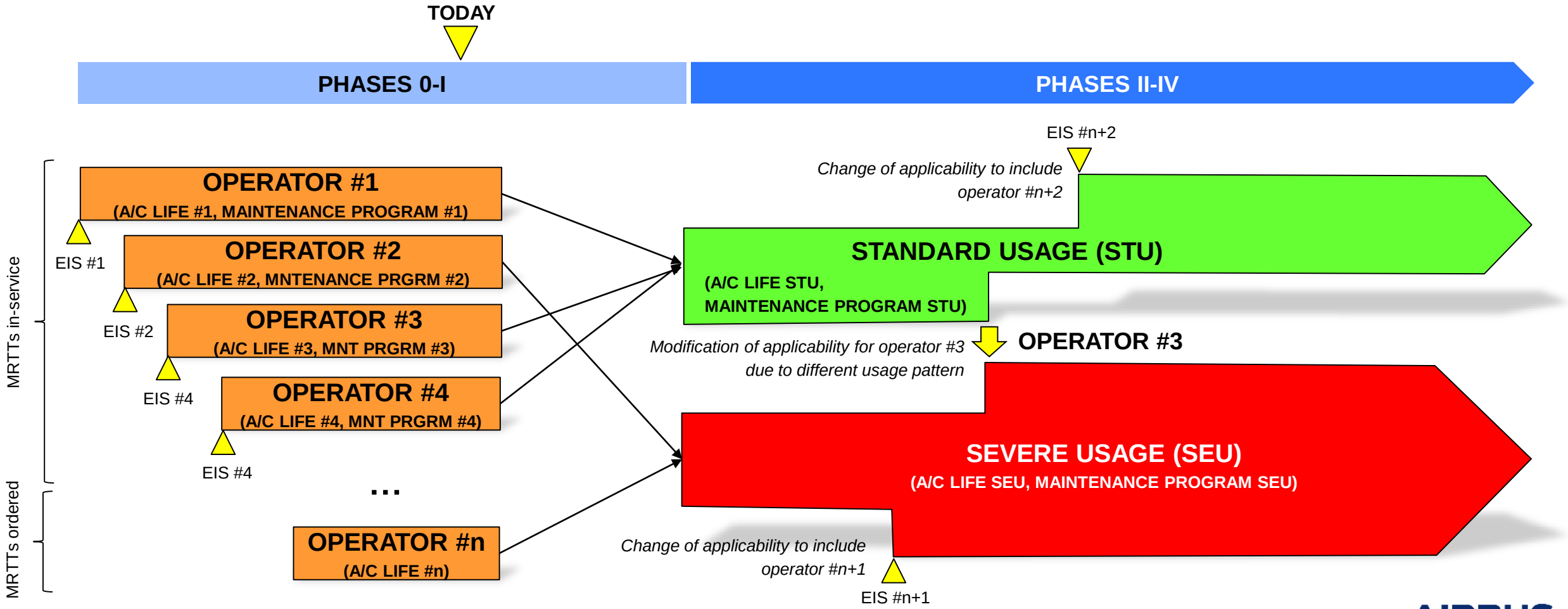
CONFLICT TIME

UNSCHEDULED OPERATIONS

PLATFORM PRESERVATION PRACTICES NOT FEASIBLE

MRTT SLEP usage flexibility activities

After the initial allocation to STU and SEU, the **arrangement will be dynamic** in order to allow future incorporations and/or modifications (e.g. changes in usage patterns):



MRTT SLEP technologies

MRTT SLEP technologies

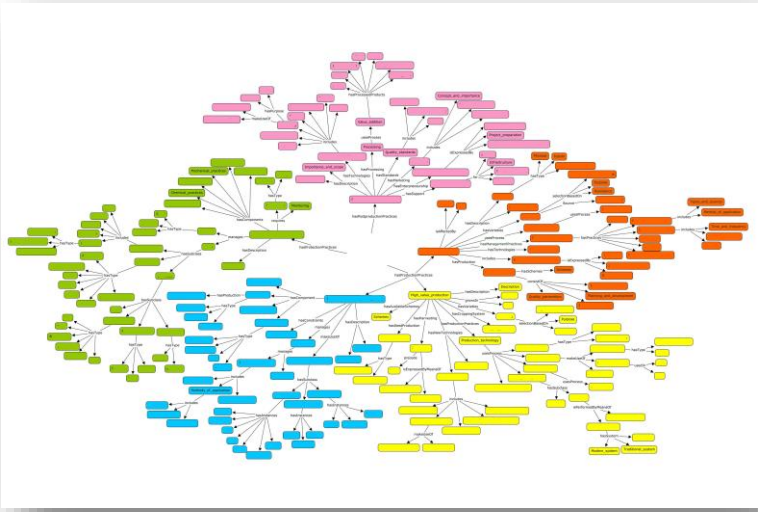
From an engineering point of view, the main challenge of the MRTT SLEP process is linked to the required balance between two opposite forces: higher flexibility in the usage patterns (that traditionally leads to the need of conservative assumptions in the analyses and in the associated maintenance practices) and minimization of the maintenance costs.

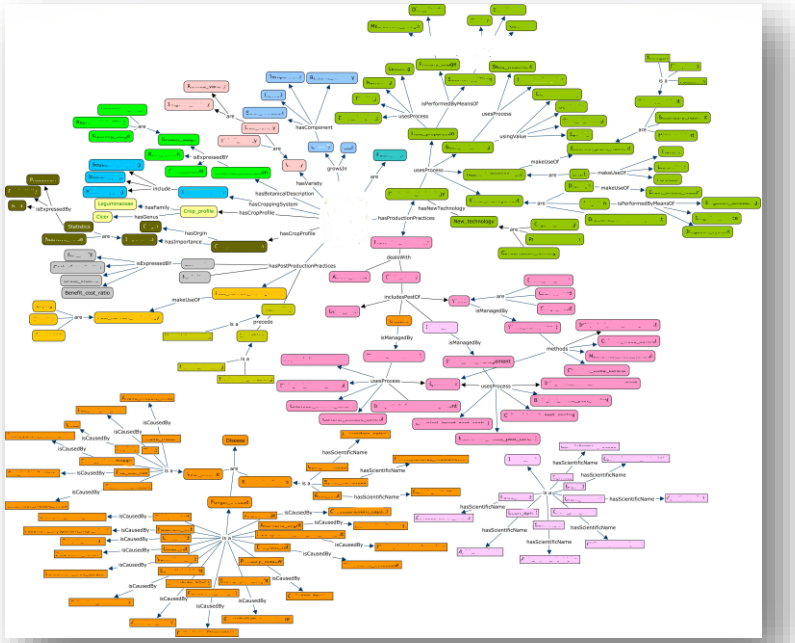
To achieve this challenge, a **new set of technologies** have been introduced with three aims:

- Better understanding of the usage patterns of the different Air Forces and extrapolation of future trends
- Enhanced capability of evaluating multiple usage scenarios
- Refined analysis capabilities

MRTT SLEP technologies

The usage assumptions to be considered for the SLEP have been obtained from a wide range of sources: Individual Aircraft Tracking (IAT) data downloaded and processed with the Structural Health Monitoring System (SHMS) most of the A330-MRTTs are fitted with, usage projections from the Air Forces and internal data based on commercial surveys. All this information has been **consolidated in one single repository** and analysed using new methods (so-called '**usage relational diagrams**') to identify the links between the different flight parameters that characterize the usage and determine which are the most important in terms of SLEP targets (life stoppers, usage flexibility stoppers). The results of this analysis have been essential in the definition of SLEP terms, particularly the usage regions STU and SEU.



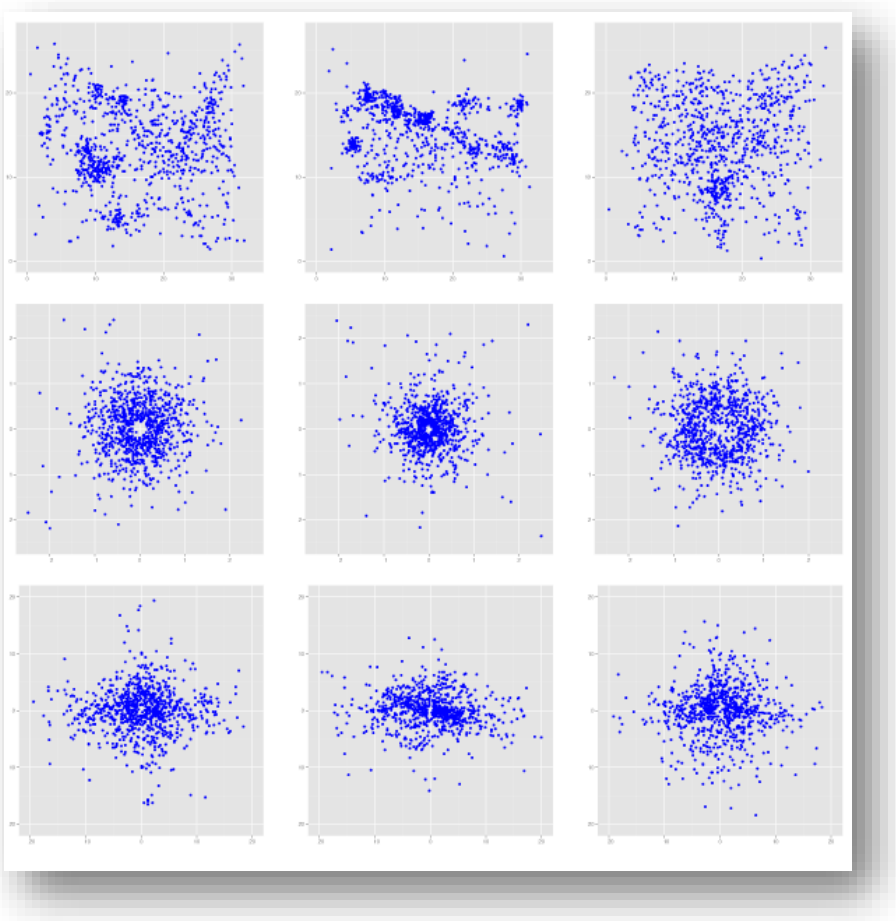


MRTT SLEP technologies

Once the usage has been properly characterized, it is necessary to have the capability of running multiple usage scenarios in order to assess the impact in terms of damage accrual.

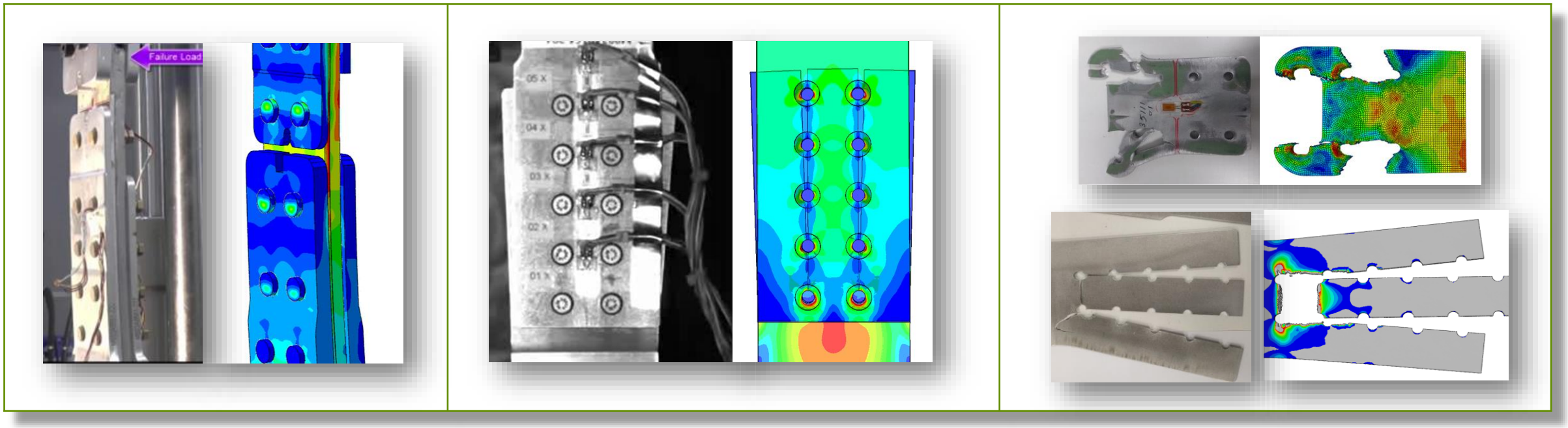
For this purpose, a new technology called '**Digital Equivalent**' is being developed. Summarizing, the Digital Equivalent is a software representation of the critical locations of the aircraft (the airframe, mainly) that enables the analysis of **many possible usage patterns** by comparison with the appropriate allowables.

This information is used to establish the ranges of the main flight parameters that characterize STU and SEU (take off weight, flight duration, cruise altitudes, etc).



MRTT SLEP technologies

A key element in order to keep the workload of the inspections included in the maintenance program is the ability to remove conservative assumptions inherent to the analytical assessments. For this purpose, a new generation of **high-fidelity simulation techniques** has been introduced to help in the optimization of the maintenance requirements.



Conclusions

Conclusions

Air Forces are using the MRTT platform in a far more intensive way than expected due to its flexibility and reliability.

Airbus DS has launched an SLEP process to cover this higher rate of effort, along with any evolution in the usage patterns. This process is a long-term commitment with the MRTT fleet to be applied throughout the lifecycle of the aircraft.

The SLEP of A330-MRTT benefits largely on the A330 results and evidences, thus simplifying the process and reducing the costs traditionally associated to life extensions. Most of the dedicated engineering activities are concentrated on the military systems, particularly Boom.

Some new technologies are being applied in order to enable larger flexibility in the usage while minimizing the associated maintenance workload.

Thank you

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