

Impact of On-line Operational Reliability Re-assessment on Aircraft Maintenance Policy

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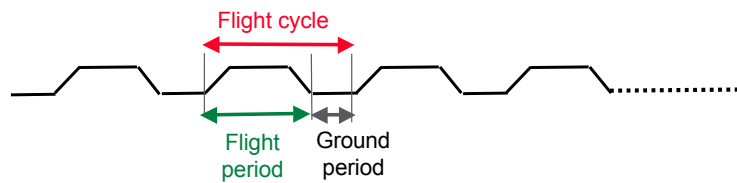
61st meeting of the IFIP 10.4 Working Group on Dependable Computing and Fault Tolerance
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Objectives

- ☞ Forecast operational reliability while in service considering
 - Mission profile
 - Aircraft operational state
 - Maintenance facilities
- ☞ Whenever needed
 - Mission planning
 - Maintenance planning
 - Missions achievement
- ☞ To avoid as much as possible mission disruptions

Mission

☞ Mission: sequence of flight cycles

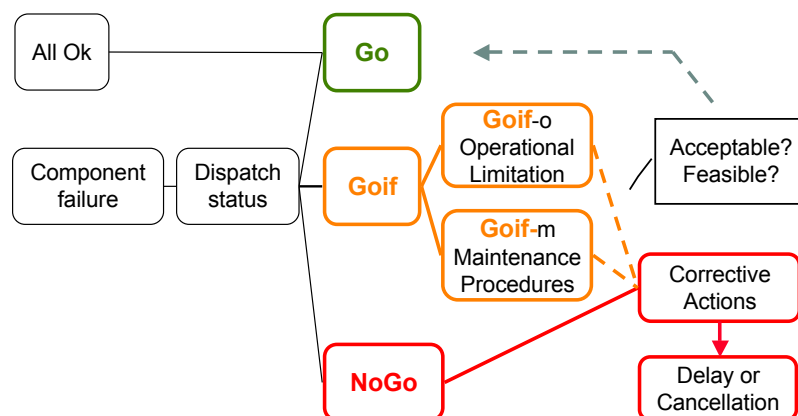


☞ Requirements

- System + mission
- Requirements fulfilment verification for each flight
- Requirements non-fulfilment operation \Rightarrow disruption/interruption

3

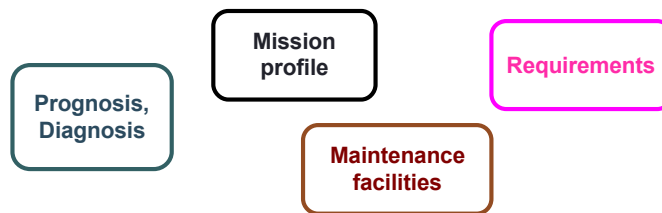
Dispatch Decision



4

How to Reach the Objectives?

- ☞ Use dependability models
- ☞ Easily updatable to capture all relevant information



- ⇒ Evaluate the probability to operate without operational disruption/interruption until a given time or location
→ before and during mission achievement

5

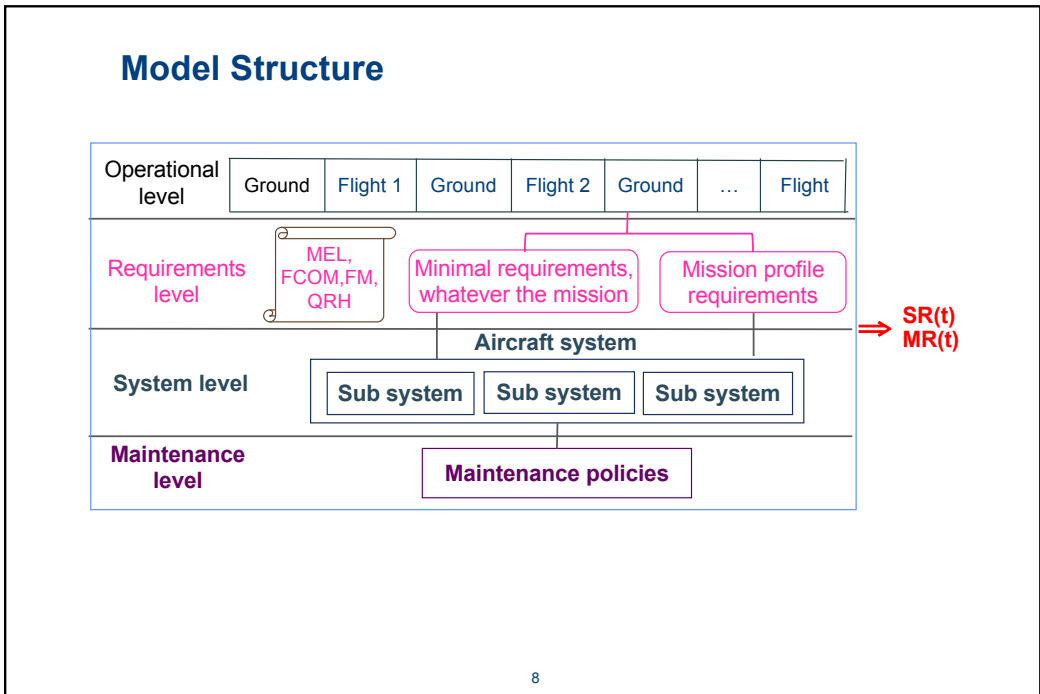
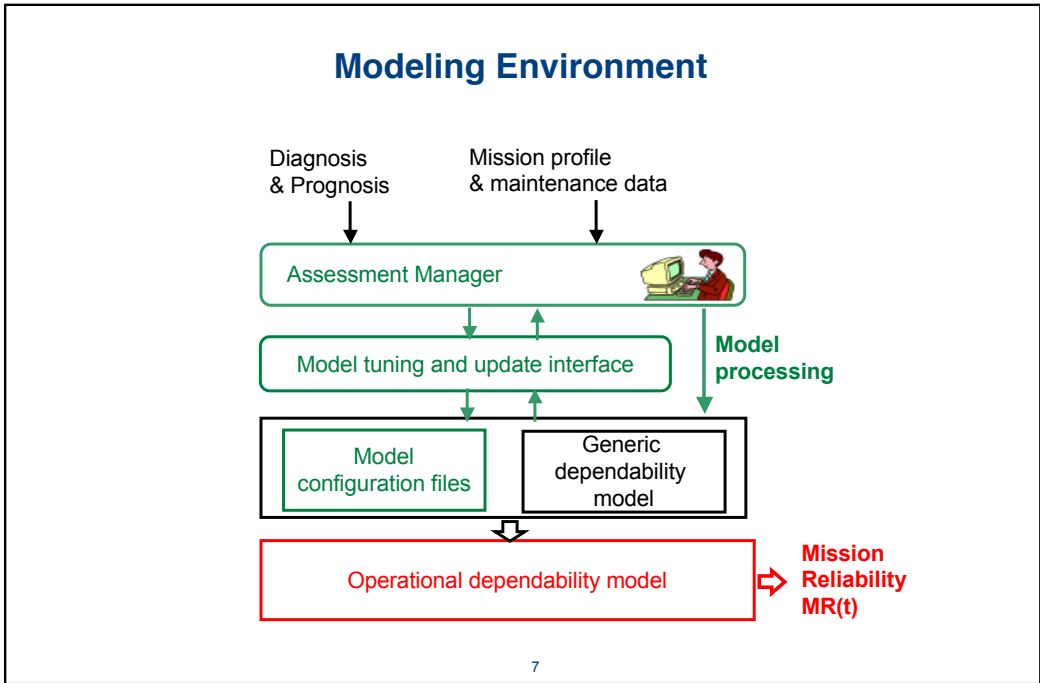
Dependability Measures

- System reliability, $SR(t)$
Probability to meet the common requirements related to the system, during t flight hours.
- Mission reliability, $MR(t)$
Probability to achieve the mission without mission interruption

Interruption

Delay, flight cancellation, in-flight turn back, diversion

6



☞ Modeling formalism

- AltaRica, Stochastic Activity Networks, SANs (equally expressive)
- Proprietary tool

☞ Generic model

- Original Equipment Manufacturer (OEM)

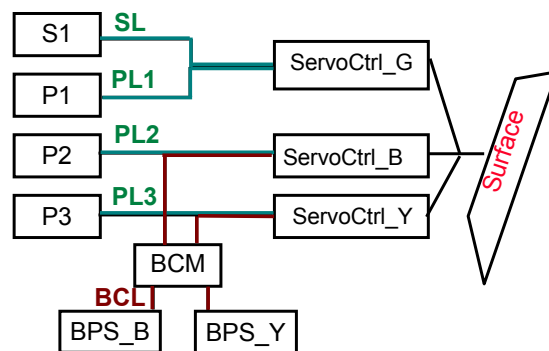
☞ Model update

- Non specialists, Maintenance, Repair, and Operations (MRO's)

9

Example of sub-systems: the rudder system

Control Lines



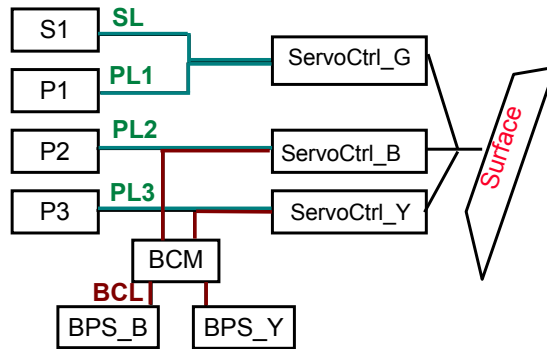
Initially: S1, BCM, BPS_B, BPS_Y inhibited

After failures of P1, P2 and P3: activation of S1

After failures of P1, P2, P3 and S1: activation of BCM, BPS_B, BPS_Y

10

Example of sub-systems: the rudder system



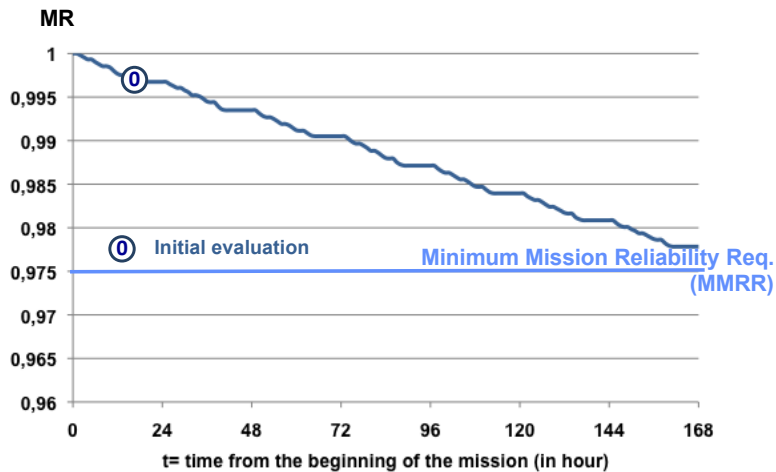
Operational requirements:

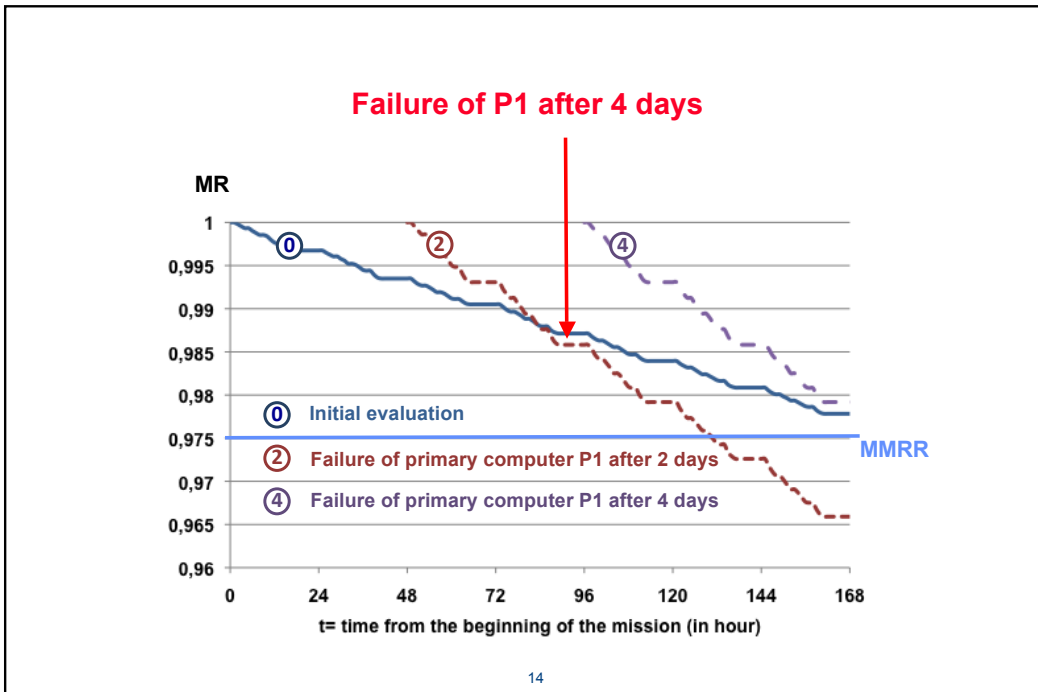
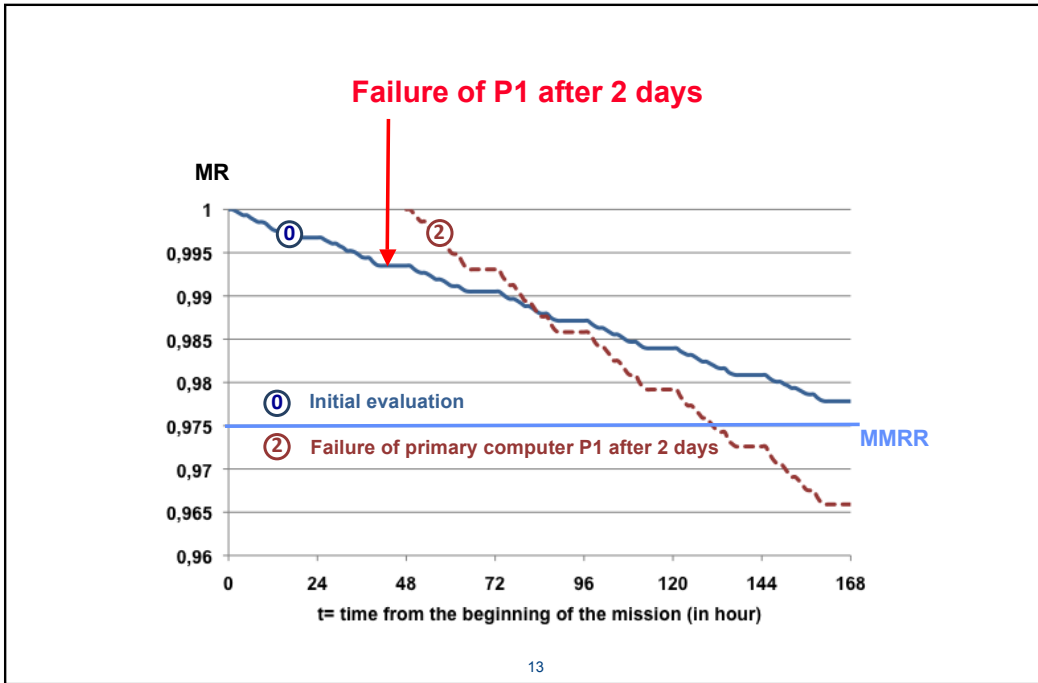
Goif: failure of P1, P3, S1 → conditions stated in MMEL documents

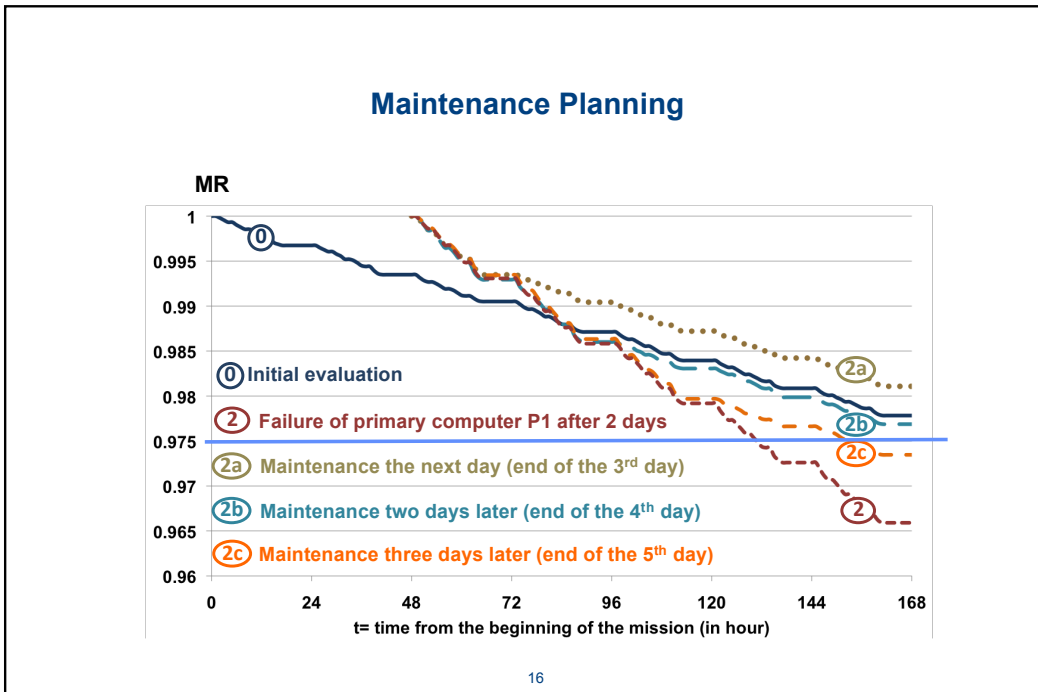
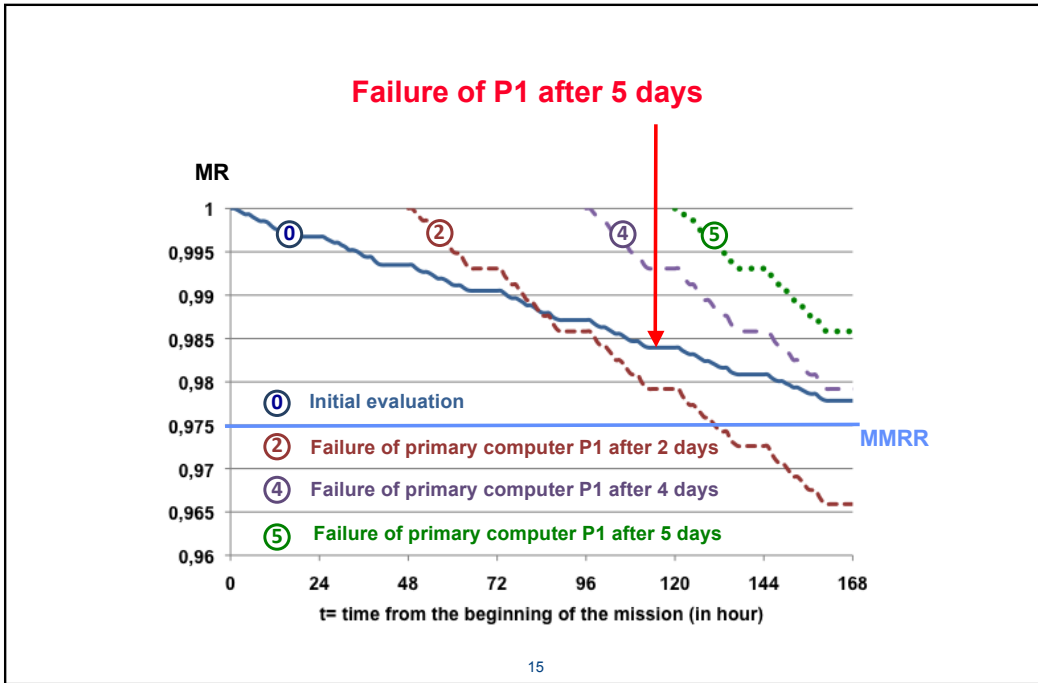
NoGo: P2, ServoCtrl_G, ServoCtrl_G, ServoCtrl_G, BCM, BPS_B, BPS_Y

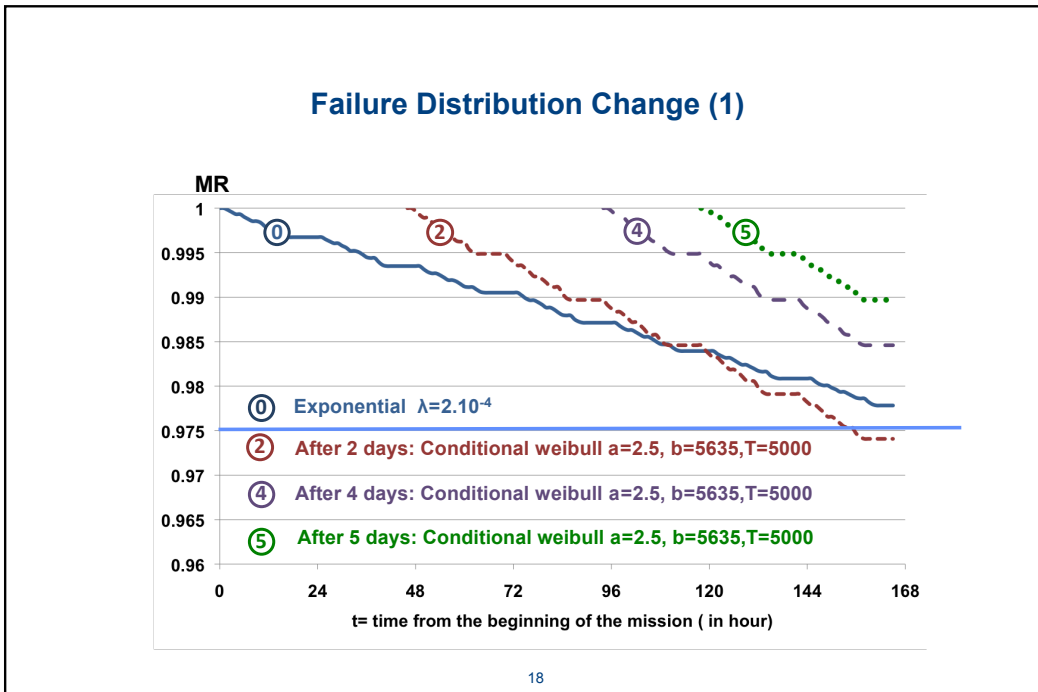
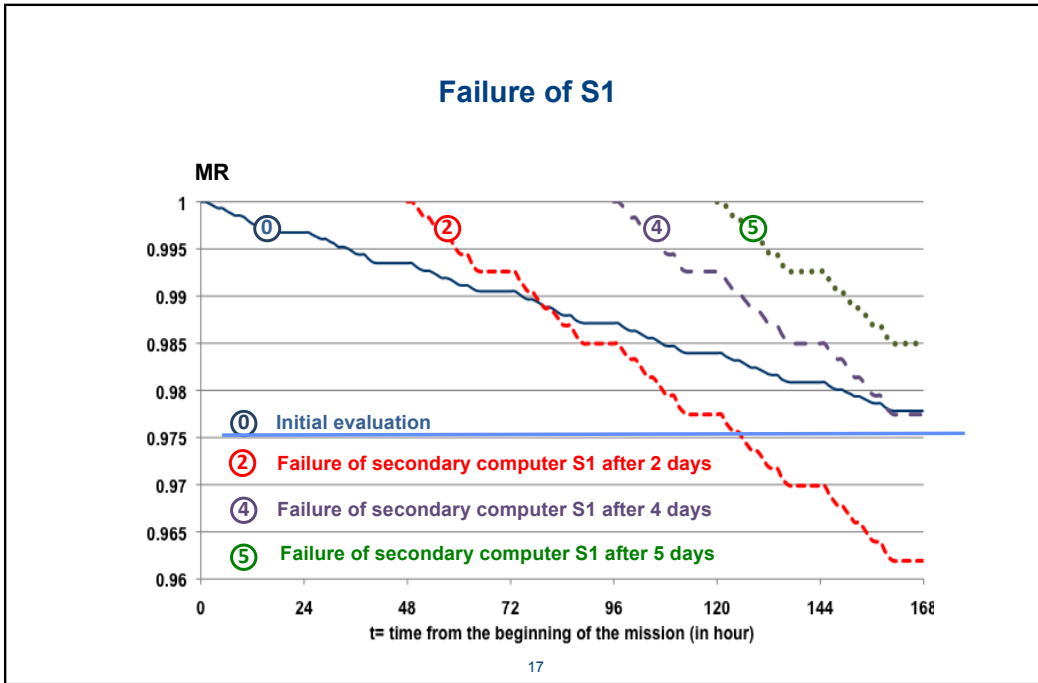
Example of results for the rudder system

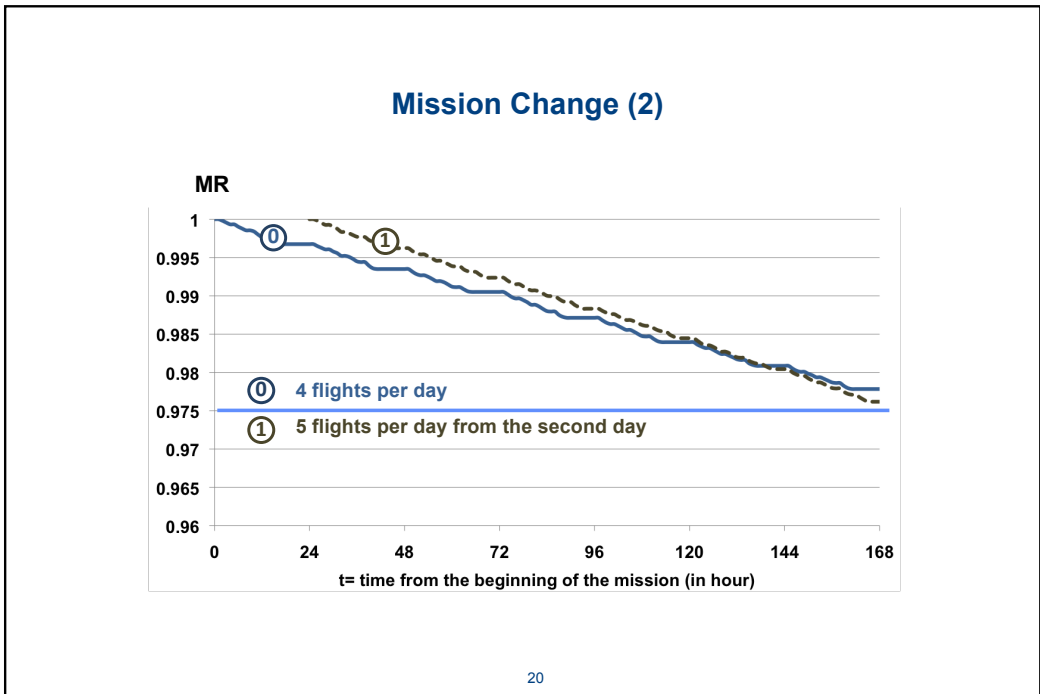
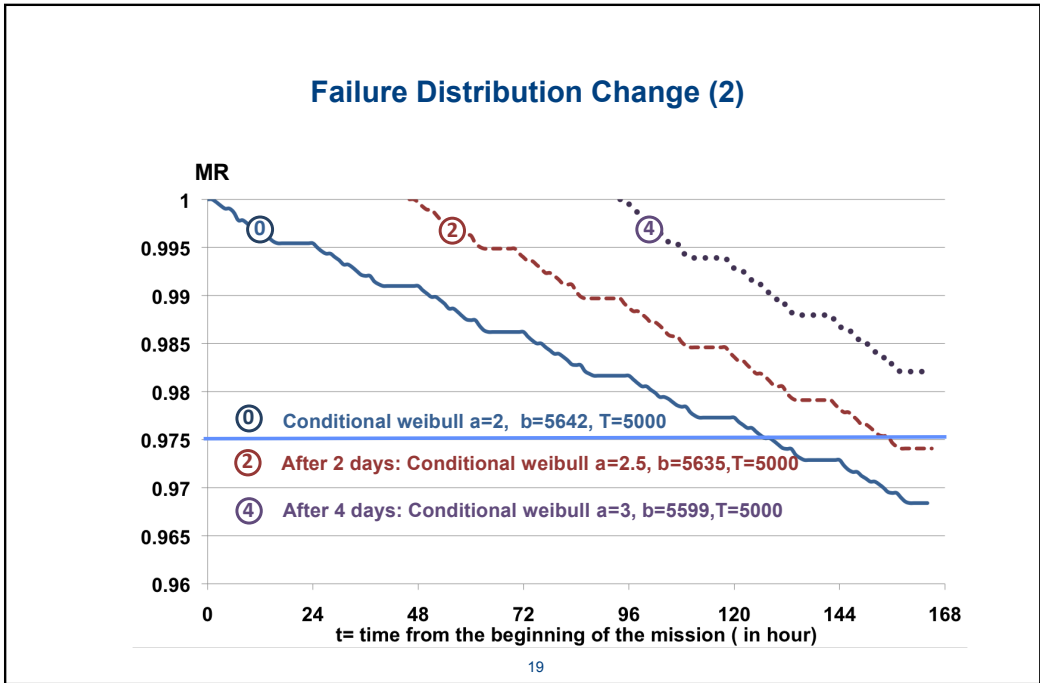
Mission Reliability evaluated before the start of a mission
(7 days, 4 flights/day)



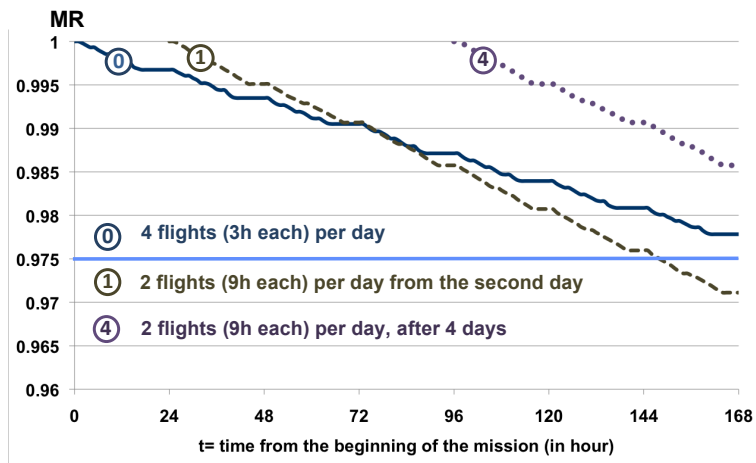






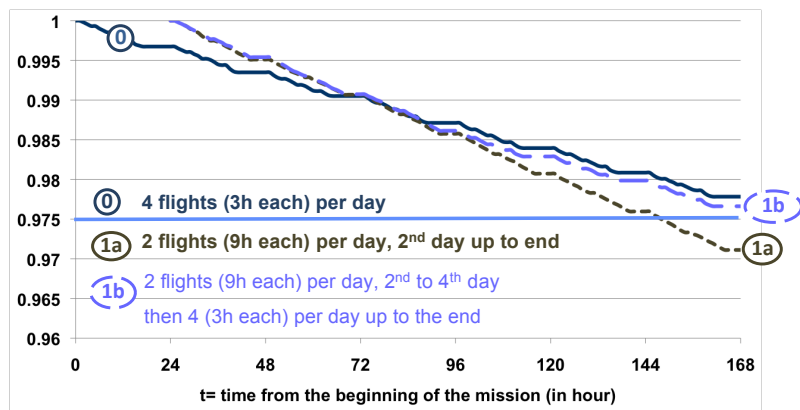


Mission Change (1)



21

Mission Change (2)



22

Conclusion & current/future work

- ☞ Operational reliability improvement using model based assessment
 - ☞ Modeling approach consisting in structuring the global model into levels
 - ☞ Formal specification of the model, potential changes and implementation rules
 - ☞ Illustration based on a case study → feasibility
 - ☞ Current work: specification of the interface for model update
- + development of the model processing module (ONERA)