Satellite Operations

A Safety and Efficiency Win Win Opportunity

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Ein Unternehmen des DLR

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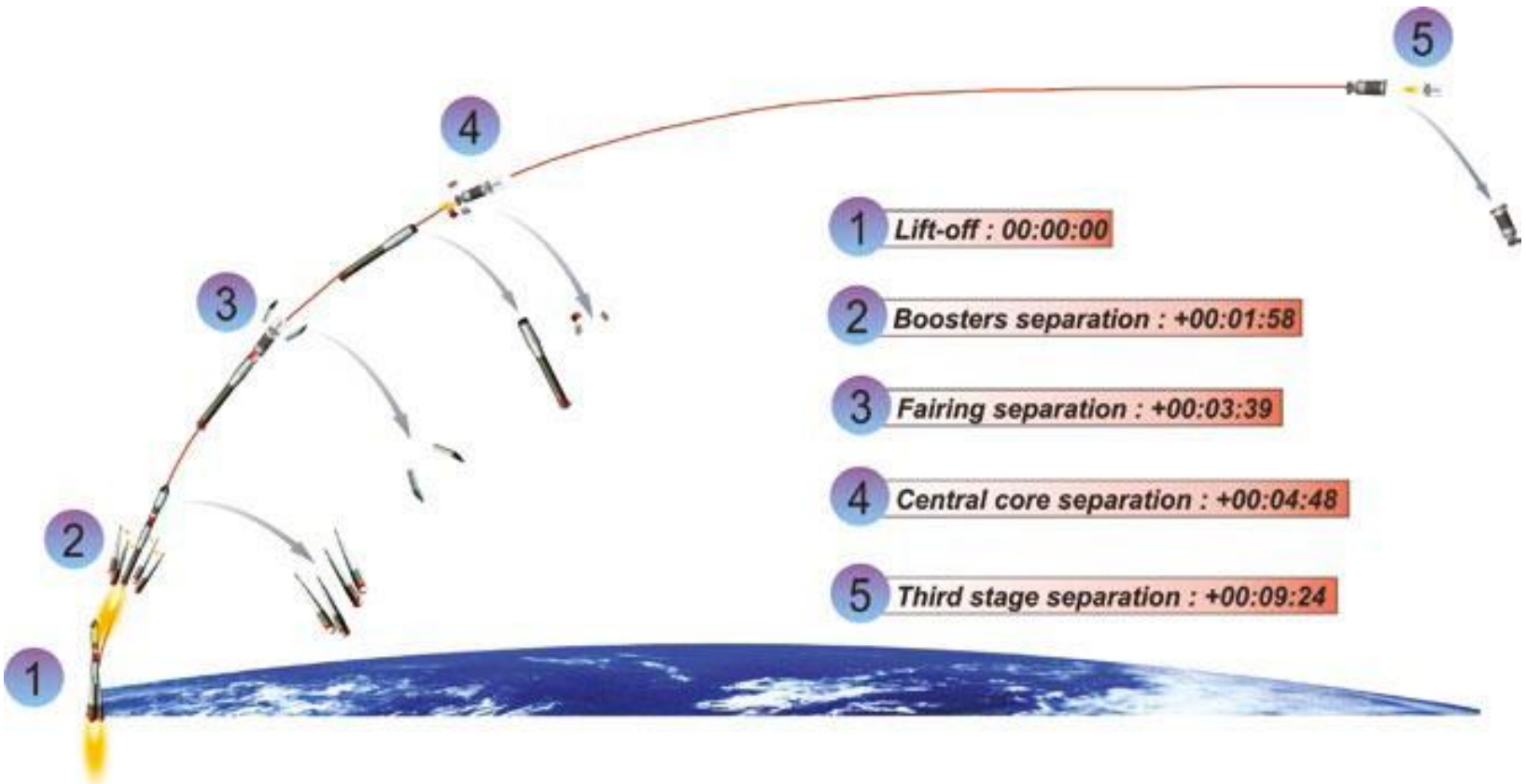
Operating Satellite Constellations

- DLR GfR Operating the Galileo satellites and hosting the control center in Oberpfaffenhofen, Germany
- DLR GfR holds an Air Navigation Service Provider certificate

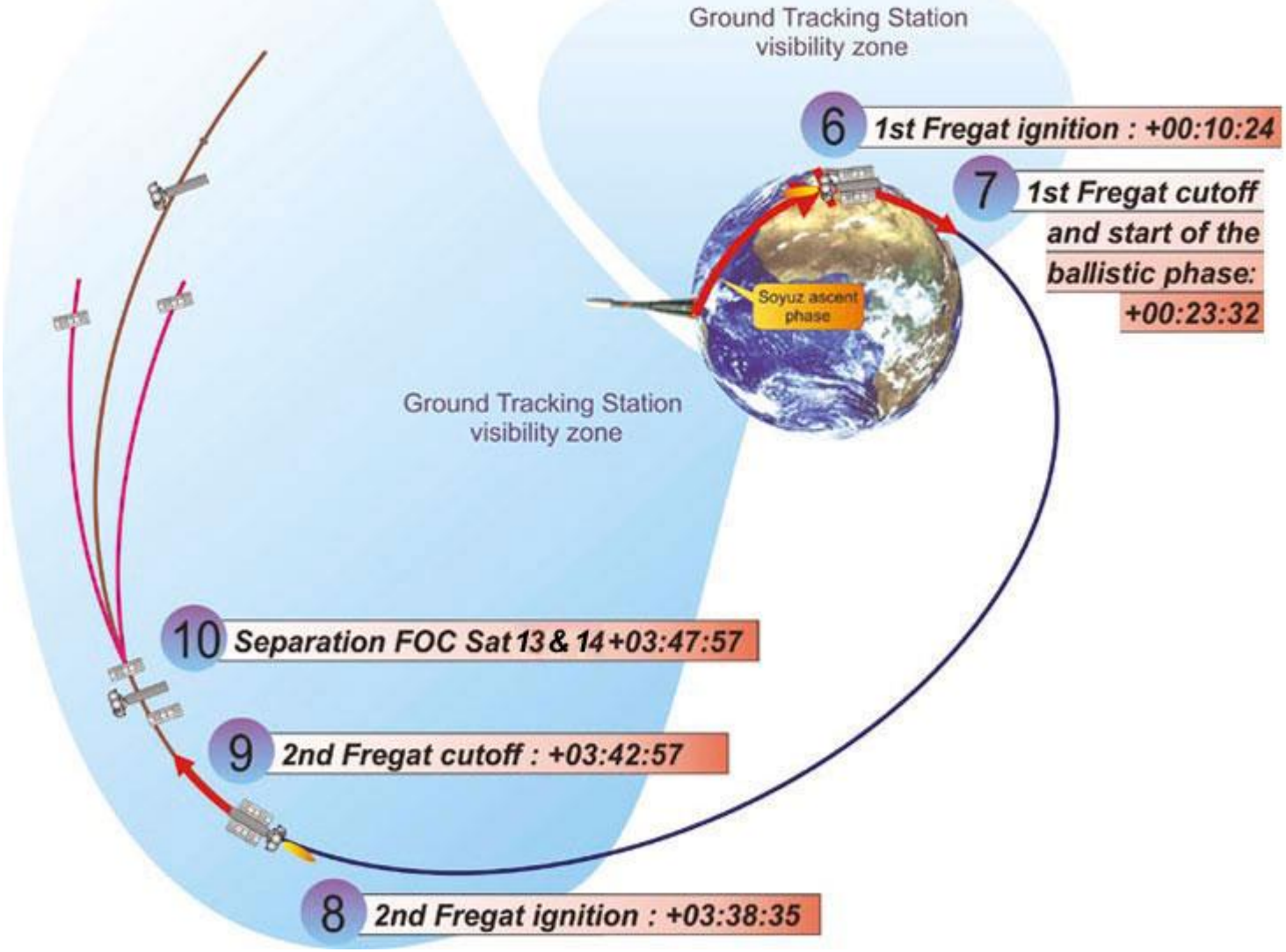
A Launch is obviously a safety challenge

The first 10 minutes



Credit: Arianespace

The first 4 hours



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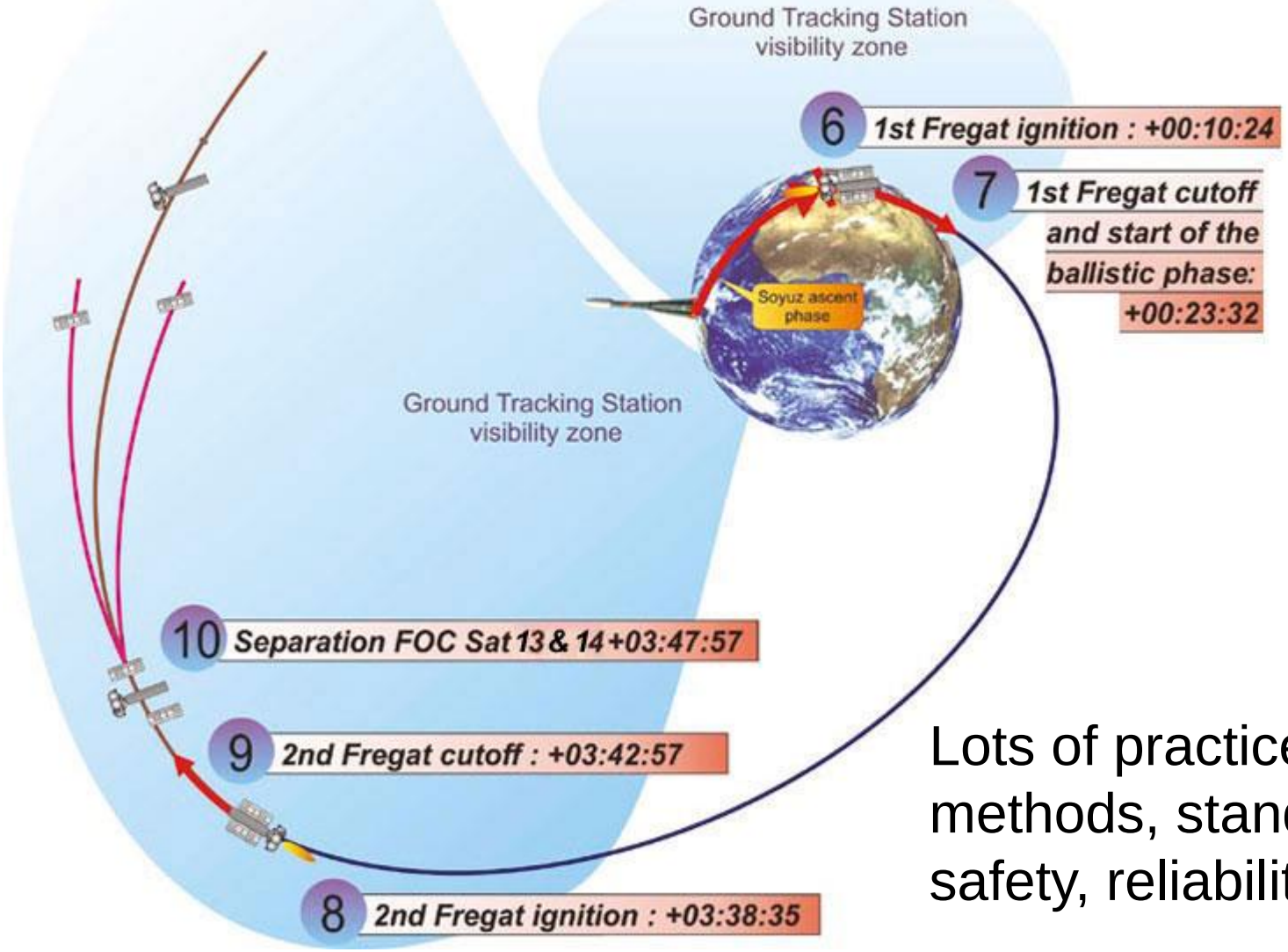
The first 4 hours



Lots of practices, methods, standards for safety, reliability

Credit: Arianespace

How safe are we?

Systems Robust and Safe: 70 + Launches with no accident

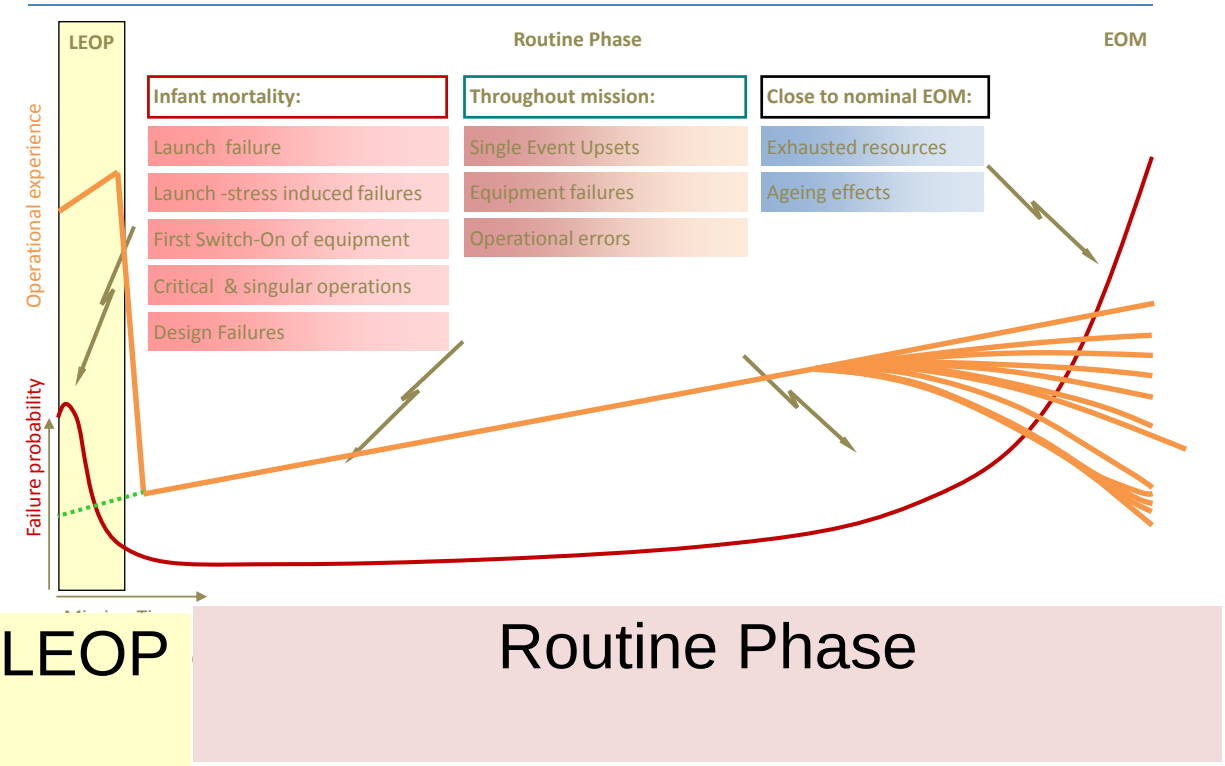
But also launch catastrophes, e.g. in manned missions

- Loss of Apollo 1
- Loss of Challenger Shuttle

Major Safety research topics:
introduction of new technolgies/materials and space debris.
Methods considered sufficient, still application challenging.

Satellite Operations – a traditional view

Satellites are robust
Routine operations is straight forward



Credit: DLR

What happens after LEOP – the few first days? Operations doesn‘t look as adventurous anymore!

Safety Management Challenges in „Routine“ Operations for Satellite Systems

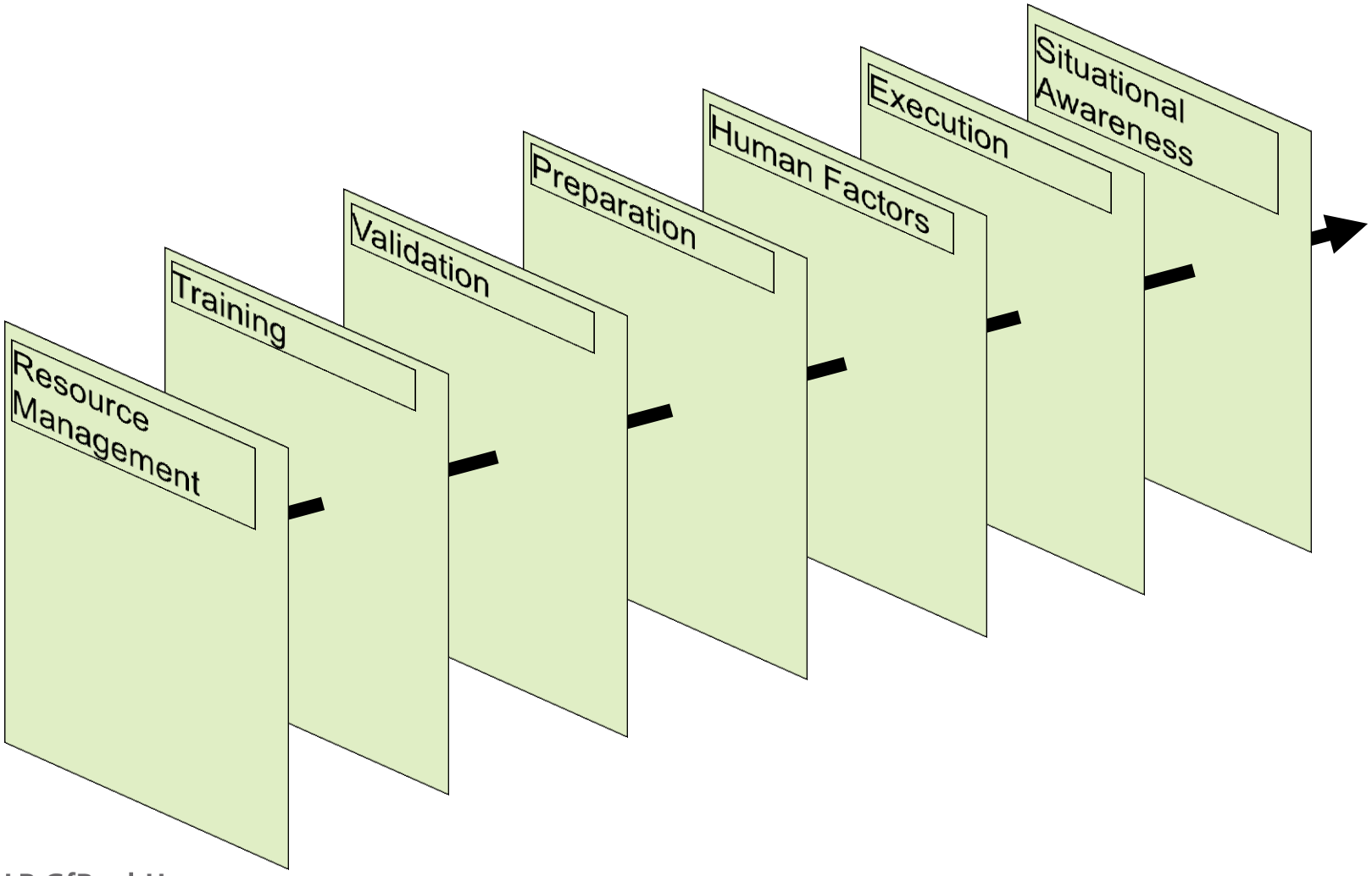
- Overall Systems impacts driven by changing and growing sub-systems

- Day to day operations, with scare resources – **fuel is not reloadable**

  You may be able to recover but when it needs fuel it will shorten the lifetime of a mission

→ Enforce attention for „small, medium“ impact and day to day operations – “SAFEOPS”

Protection layers – contributors not root causes



1) Protection layers as assessment tool - non quantitative

- Structured discussion
  complementary to route cause analysis

- Topics not in the “technical scope or comfort zone”:
  - Resilience Management
  - Resource Management
  - ….

- How to describe the protection mechanisms between layers?
  Improve checklists and avoid “over – protection”

2) Protection layers – metrics for proactive layers assessment

- Use and refine available metrics:
  No of errors, error closing time
  No of operator errors, …

- also from non-technical functions:
  HR: Work satisfaction
  Controlling: Resources, work load
  Training: Qualification rates, simulation participation, ..

- How to assess combined metrics – “score card 2.0”?
  Identify “holes” not just overall average status

Things done well

- Eurocontrol Safety I to Safety II, Hollnagl, Reason e.a.
- From Safety-I to Safety-II, a whitepaper, Hollnagl, Wears, Braithwaite, 2015

Automation needs Things done well

Satellite Operators execute strictly defined procedures using a set of complex tools

Much of this can be automated once systems have been robustly introduced, supporting both efficiency + safety in growing constellations

- Introducing automated procedures shows that (experienced) operators use a wide „background“ know how beyond specified tasks

Identifying „Things done well“ – first steps

- Methods from Knowledge Management: Experts interviews and story telling

- New employees feedback when applying know how from training supported by coaches

- Lessons Learned

Learnings from Safety Management:
- Safety Protection layers to guide information collection

Weakness in other layers asking for „things done well“ – frequent needs

Hollnagel, ea 2015

- „making things go right is an investment in safety and productivity“

Hollnagel, ea 2015

Safety and Efficiency Win Win

- Safety Management and Efficiency Management could benefit from jointly develop new methods for a systems world
- A joint approach will provide a much richer value proposition for safety management
- A joint approach may provide a much more rewarding and interesting work area for safety managers

Thank you!