Satellite Operations

A Safety and Efficiency Win Win Opportunity

Heinz Gloeckner

ICSC 2016
Amsterdam
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

1. Lift-off: 00:00:00
2. Boosters separation: +00:01:58
3. Fairing separation: +00:03:39
4. Central core separation: +00:04:48
5. Third stage separation: +00:09:24

Credit: Arianespace
The first 4 hours

1. **1st Fregat ignition**: +00:10:24
2. **1st Fregat cutoff and start of the ballistic phase**: +00:23:32
3. **Ground Tracking Station visibility zone**
4. **Separation FOC Sat 13 & 14**: +03:47:57
5. **2nd Fregat cutoff**: +03:42:57
6. **2nd Fregat ignition**: +03:38:35

Credit: Arianespace
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 technologies/materials and space debris. Methods considered sufficient, still application challenging.
Satellite Operations – a traditional view

Satellites are robust
Routine operations is straightforward

- Infant mortality:
  - Launch failure
  - Launch-stress induced failures
  - First Switch-On of equipment
  - Critical & singular operations
  - Design Failures

- Throughout mission:
  - Single Event Upsets
  - Equipment failures
  - Operational errors

- Close to nominal EOM:
  - Exhausted resources
  - Ageing effects

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

- Overall Systems impacts driven by changing and growing sub-systems
- Day to day operations, with scarce 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

• „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!