CubeSats in University
Using SE Tools to Improve Reviews and Knowledge Management

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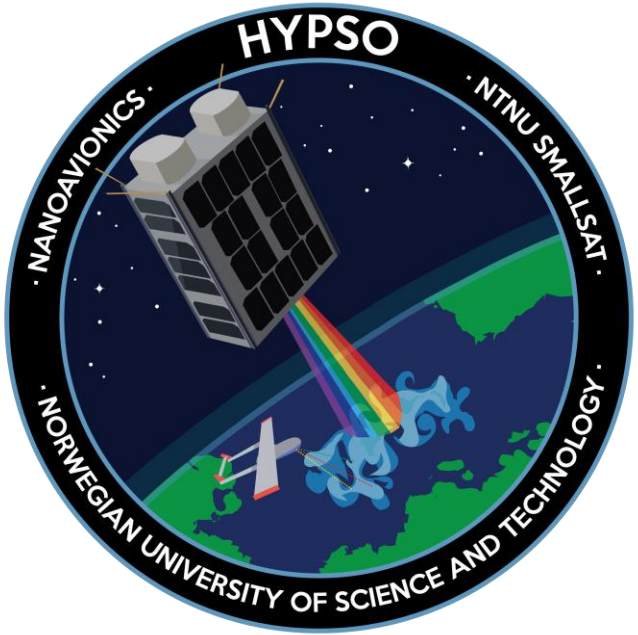


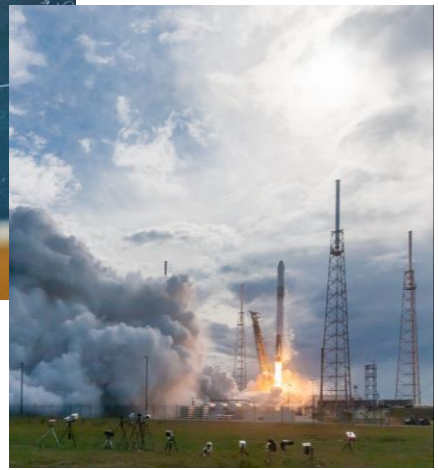
Evelyn Honoré-Livermore, evelyn.livermore@ntnu.no

Video-backup

- https://www.youtube.com/watch?v=AgHT6oOumuE

The Context

Assumptions and expectations?



Problem

The mission and requirements were handed to us

No one in our team has built a CubeSat before

Supporting faculty has not built a CubeSat before

People leave every semester

Team consists of people doing theses

Balancing research and engineering

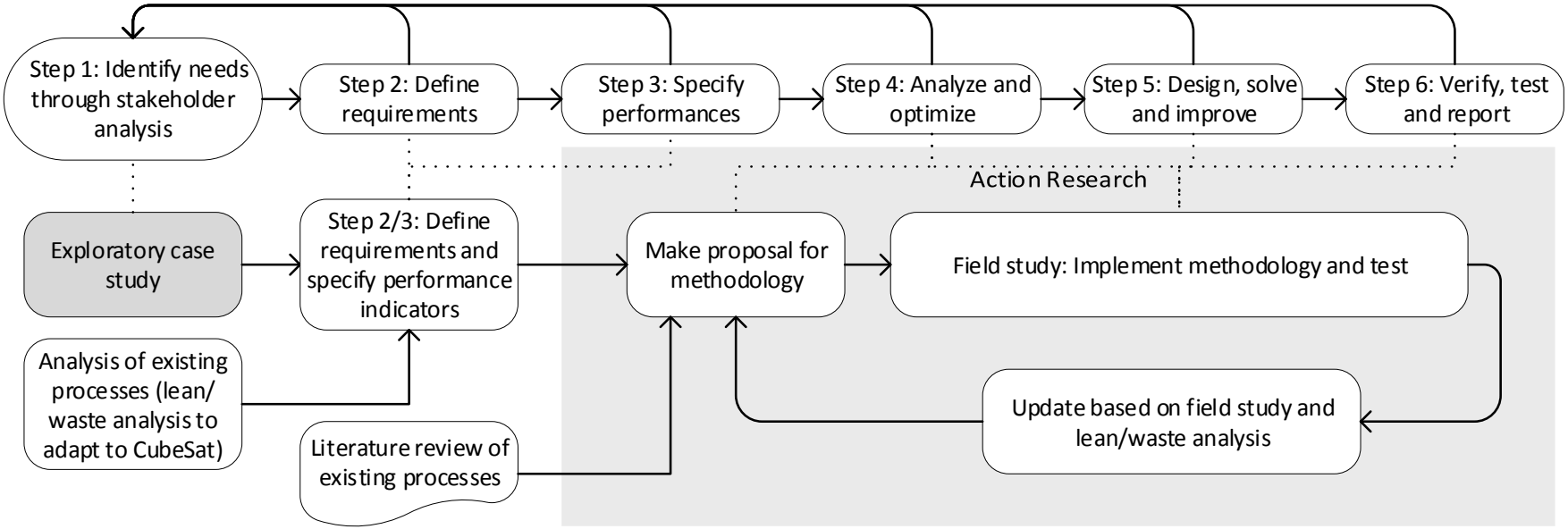
Research Questions

RQ-1: How can an engineering project ensure the fulfillment of academic research goals in a university setting?

RQ-2: How can engineering goals and individual research goals be fulfilled simultaneously?

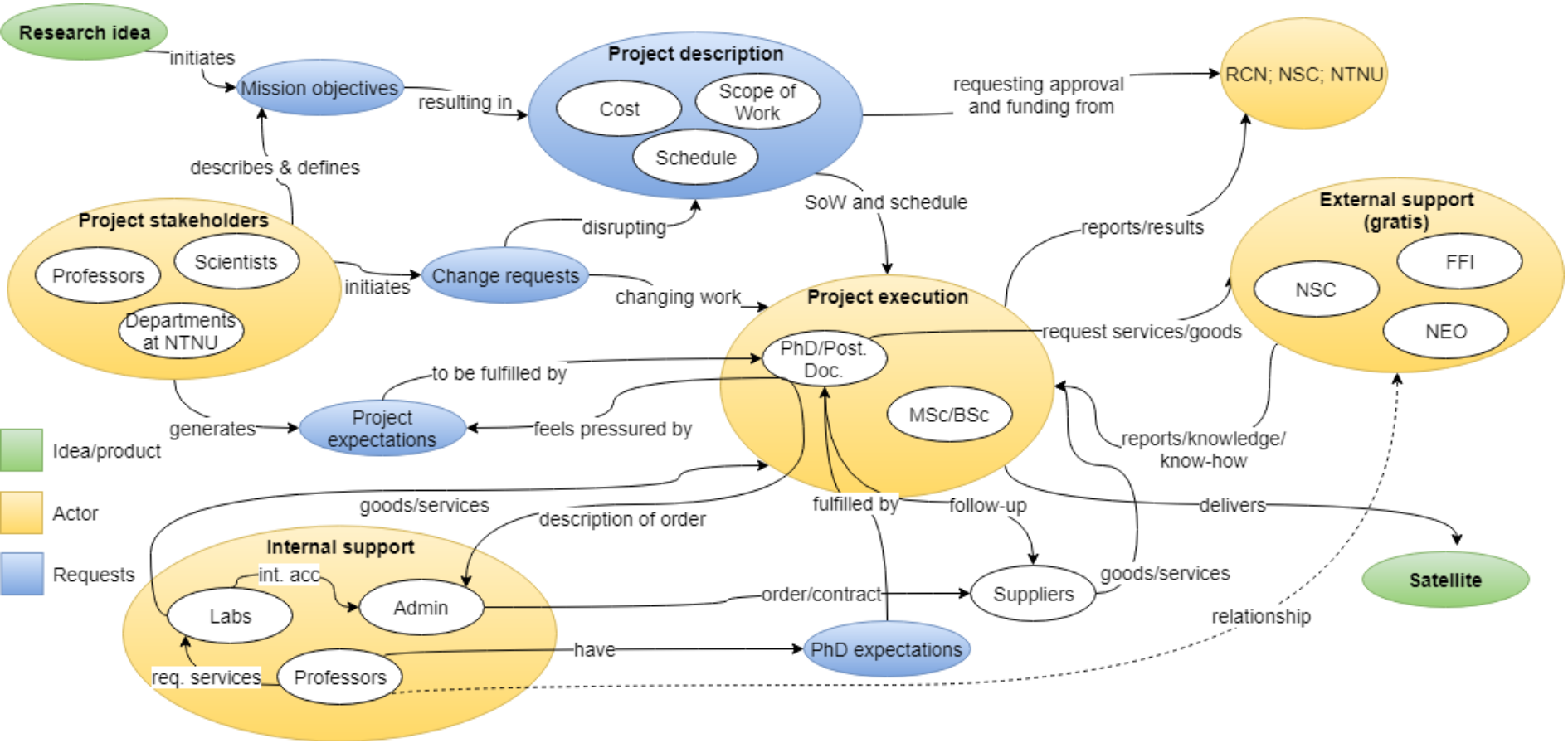
RQ-3: What methods and modes of interactions in a university research project are present, work well, and why?

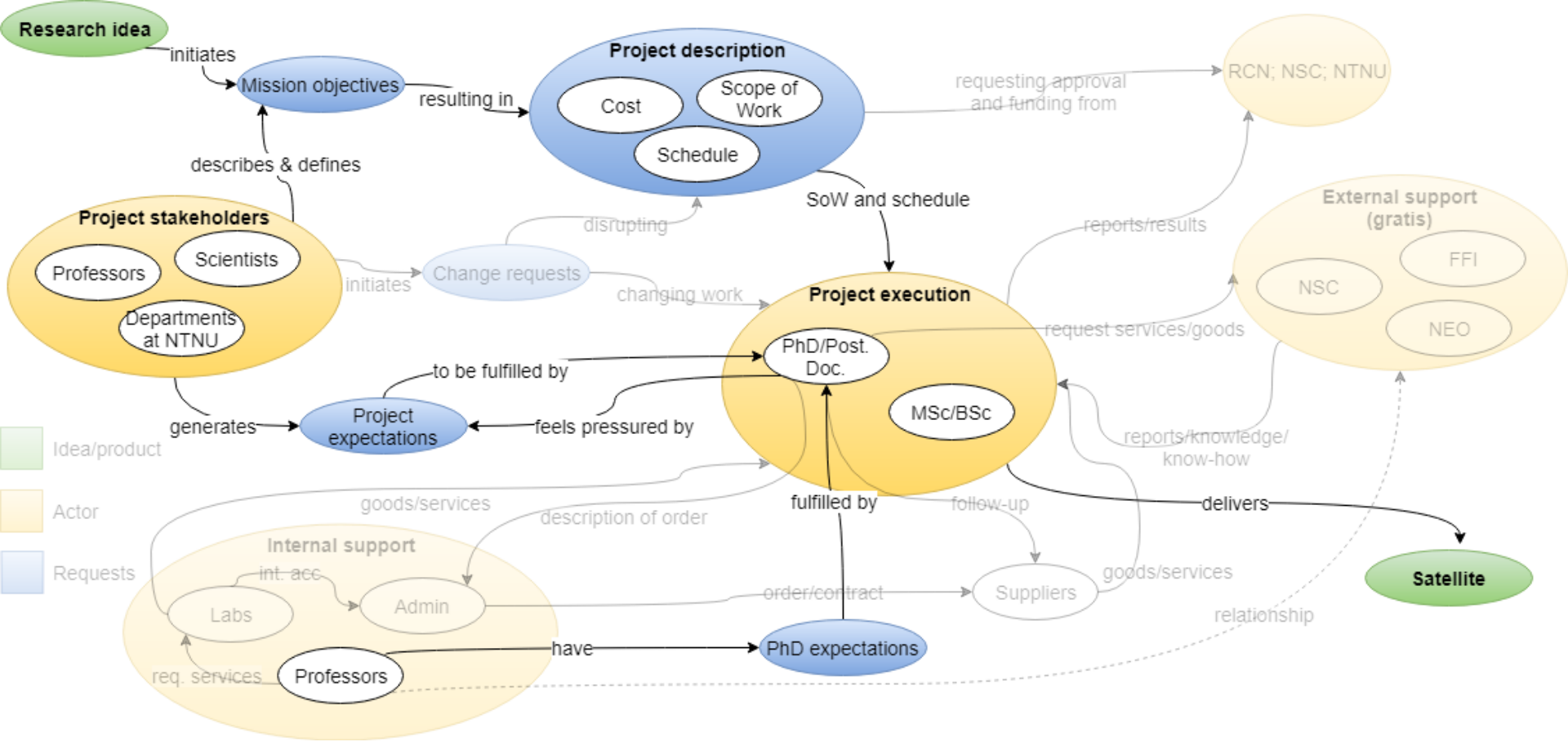
My Research


Step 1: Identify needs through stakeholder analysis
Step 2: Define requirements
Step 3: Specify performances
Step 4: Analyze and optimize
Step 5: Design, solve and improve
Step 6: Verify, test and report
Action Research
Exploratory case study
Step 2/3: Define requirements and specify performance indicators
Make proposal for methodology
Field study: Implement methodology and test
Analysis of existing processes (lean/ waste analysis to adapt to CubeSat)
Update based on field study and lean/waste analysis
Literature review of existing processes

The Context using Systemigram

- Distilling the project into a model
- Understanding the mechanisms and limitations
- Reference for discussions


Research idea
initiates
Mission objectives
resulting in
Project description
Cost
Scope of Work
Schedule
requesting approval and funding from
RCN; NSC; NTNU
describes & defines
Project stakeholders
Professors
Scientists
Departments at NTNU
initiates
Change requests
disrupting
changing work
SoW and schedule
Project execution
reports/results
External support (gratis)
NSC
FFI
NEO
request services/goods
PhD/Post. Doc.
MSc/BSc
to be fulfilled by
generates
Project expectations
feels pressured by
reports/knowledge/ know-how
Idea/product
Actor
Requests
goods/services
description of order
fulfilled by
follow-up
delivers
Internal support
int. acc
Labs
Admin
order/contract
Suppliers
goods/services
Satellite
relationship
have
PhD expectations
req. services
Professors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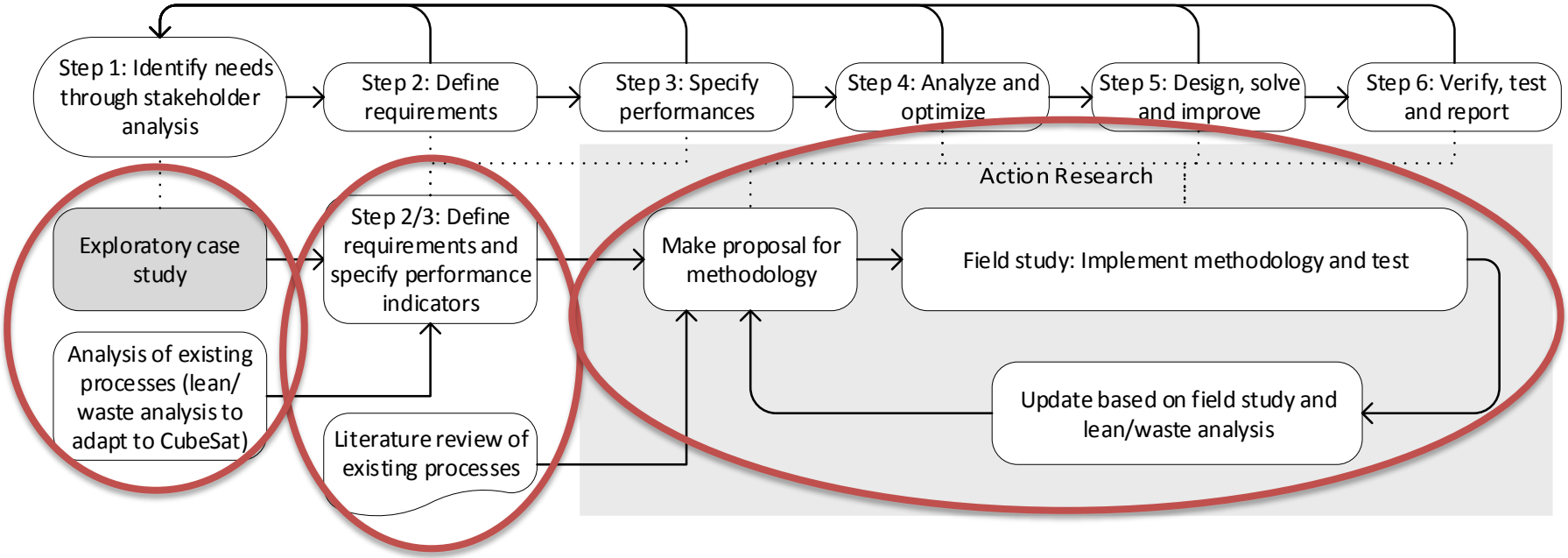
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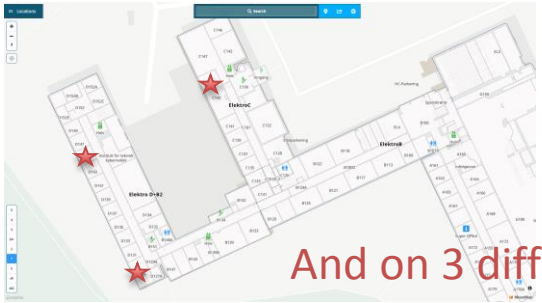
Concurrent Engineering

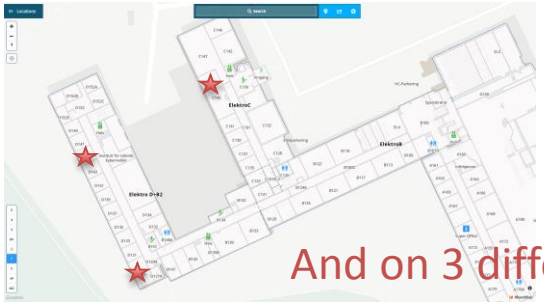
- 2017/2018
  - Decentralized team
  - Asynchronous communication
  - Weekly meetings



And on 3 different floors….

Concurrent Engineering

- 2017/2018
  - Decentralized team
  - Asynchronous communication
  - Weekly meetings
- 2018/2019
  - Centralized team
  - Concurrent design principles
  - Significant time saver
  - Stronger relationships



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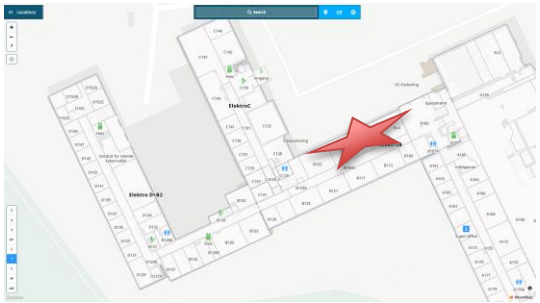


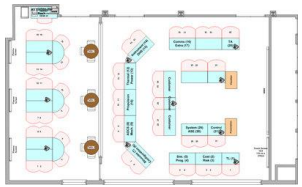
Concurrent Engineering

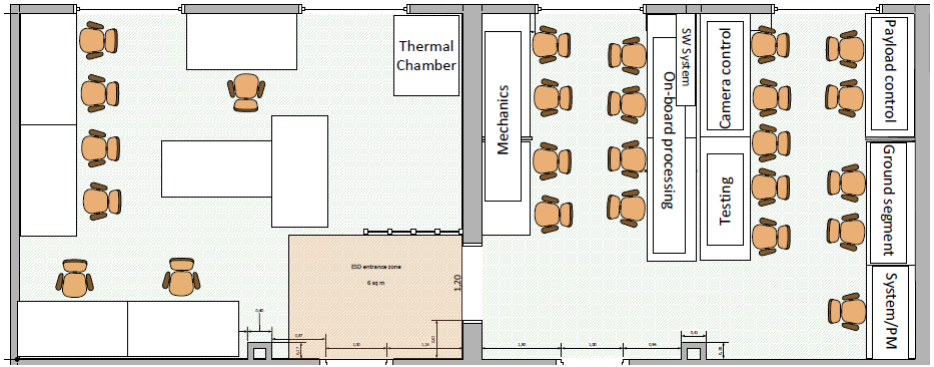
“ESA Concurrent Design Facility

- *A process*
- *A multidisciplinary team*
- *An integrated design model*
- *A facility”*

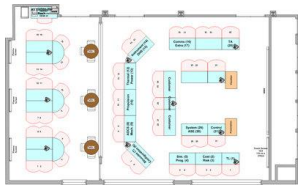
From ESA’s web page

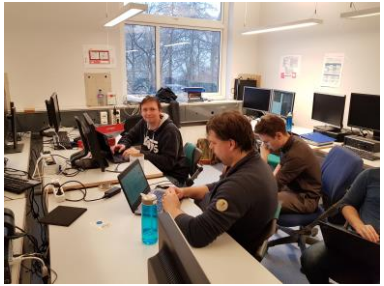
Concurrent Engineering

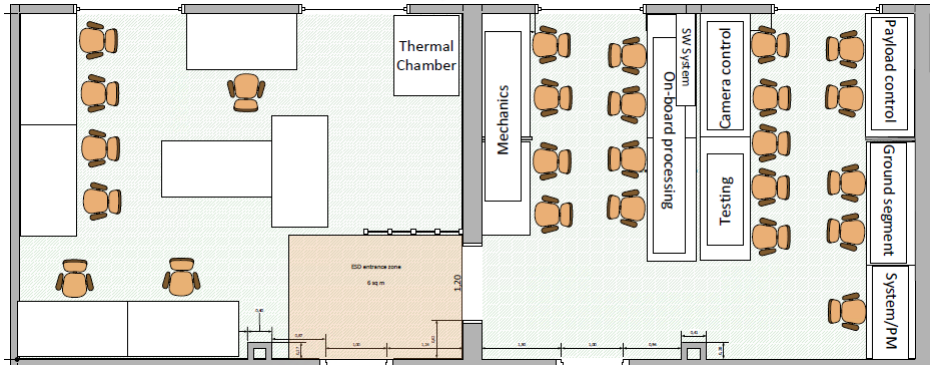




Concurrent Engineering







N2 Exercise & A3 Walls

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N2 Matrix:

- All subsystems – here: people
- Corresponding information exchange
- Used to show dependencies in development

Alberto Dallolio	5			D;	PL; API;	D;			
Joao Fortuna		6							
Joe Garrett			7	SW;	ICD;	PL; SW; ICD;			
Elizabeth F. Prentice	D;			8		PL; D;			
Mariusz Grøtte	D; PL;				9		TE		
Sivert Bakken	D;				SWA;	10			
Tord Hansen Kaasa							11	MA	
Tuan Anh Tran							WE; TE	12	
Henrik Galtung							WE		
Per-Arne Johansen							ME	ME	
Jim Meløysund							ME	ME	
Vebjørn Kristvik							MA;	MA;	

N2 Exercise & A3 Walls

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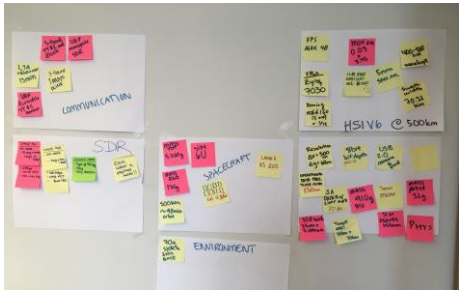
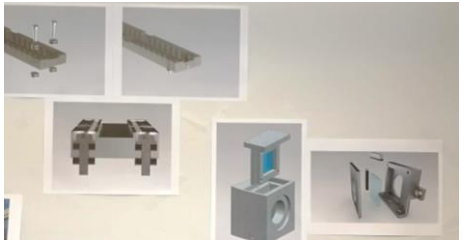
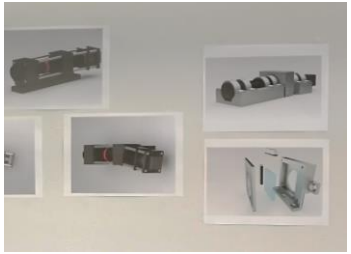


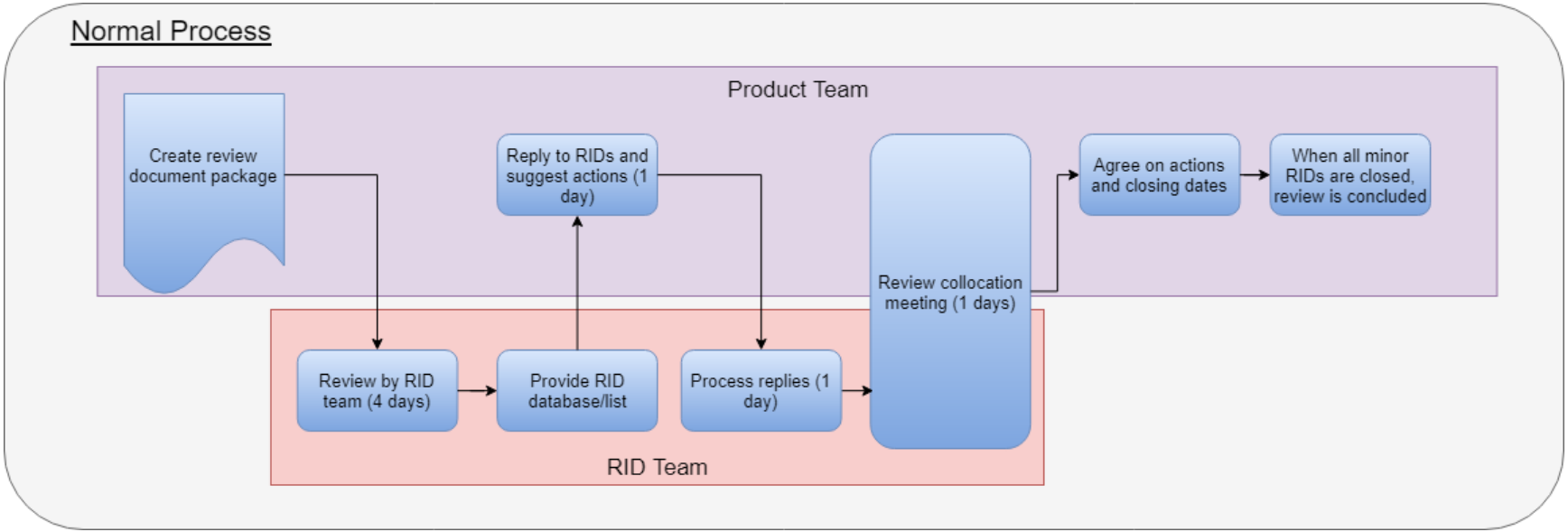




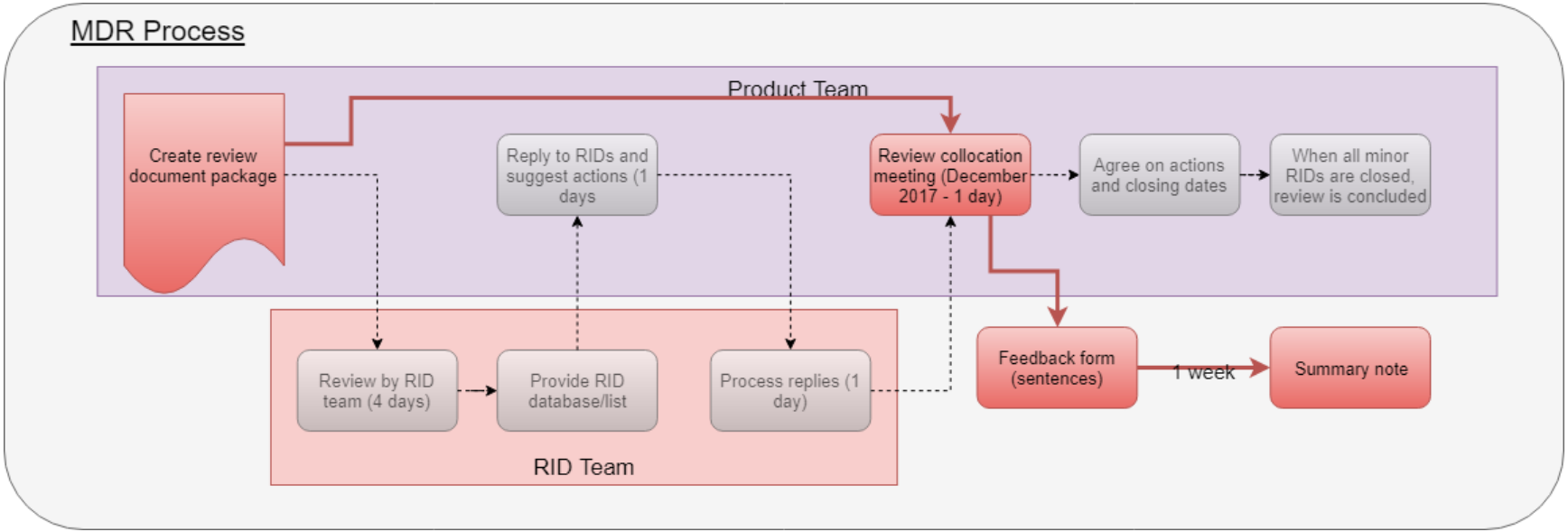
Review Comparison

- Two reviews conducted

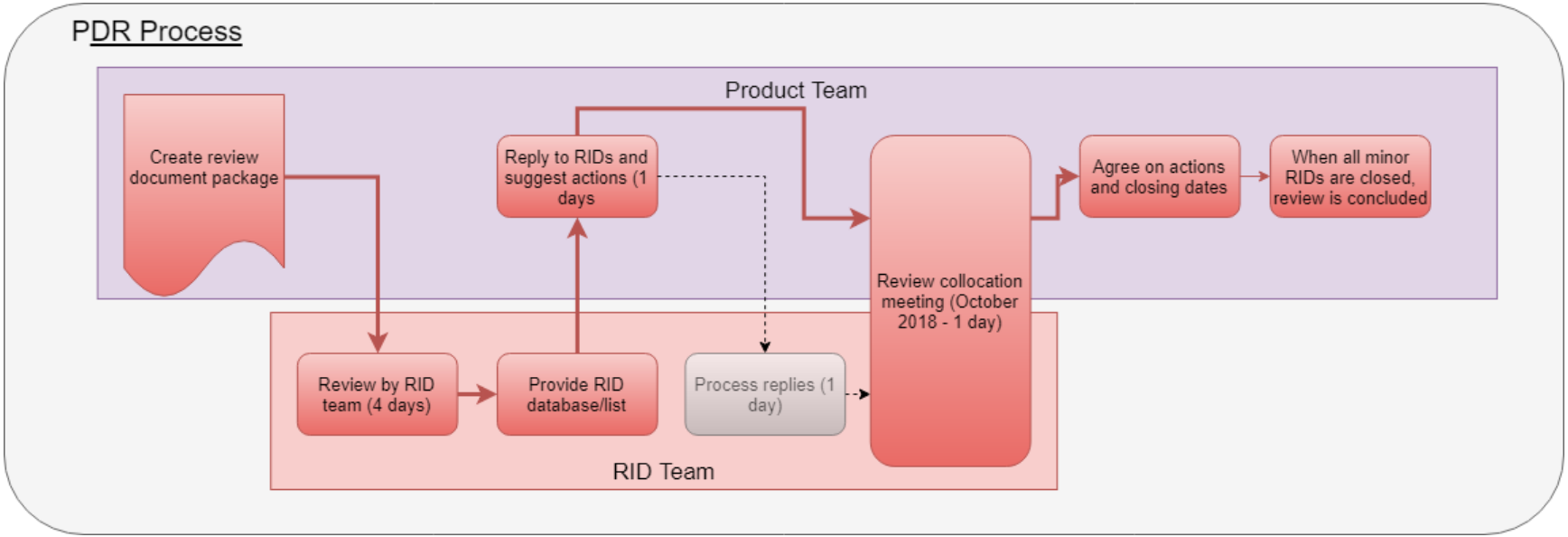
Basic ECSS Review



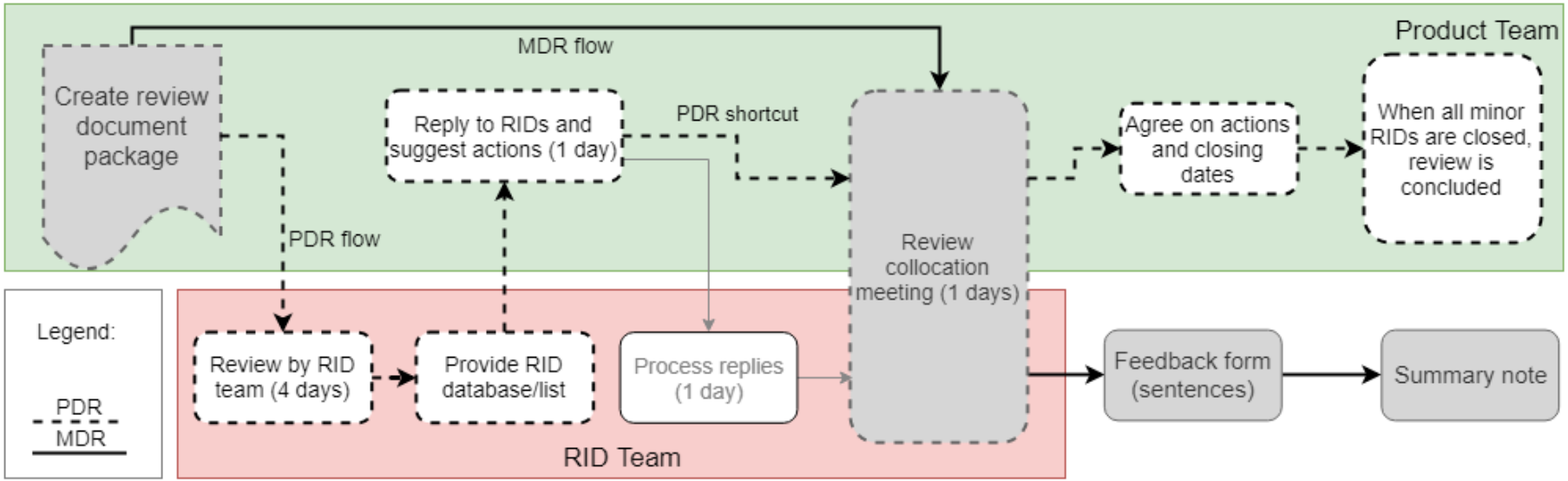
Review 1


MDR Process
Product Team
Create review document package
Reply to RIDs and suggest actions (1 days
Review collocation meeting (December 2017 - 1 day)
Agree on actions and closing dates
When all minor RIDs are closed, review is concluded
Review by RID team (4 days)
Provide RID database/list
Process replies (1 day)
RID Team
Feedback form (sentences)
1 week
Summary note

Review 2


PDR Process
Product Team
Create review document package
Reply to RIDs and suggest actions (1 days
Review collocation meeting (October 2018 - 1 day)
Agree on actions and closing dates
When all minor RIDs are closed, review is concluded
Review by RID team (4 days)
Provide RID database/list
Process replies (1 day)
RID Team

Review Comparison



Revisiting Research Questions

RQ-1: How can an engineering project ensure the fulfillment of academic research goals in a university setting?

- Workshops
- Detailed research mission requirements

RQ-2: How can engineering goals and individual research goals be fulfilled simultaneously?

- Should PhDs be a part of project execution?
- Improved review process with focus on research and engineering

RQ-3: What methods and modes of interactions in a university research project are present, work well, and why?

- Informal communication is prevalent
- Common working space
- N2 dependency map
- MBSE

Moving Forward

- Comparing secondary mission with primary mission
- New design review coming up
- Off-boarding and on-boarding through the summer – how to do knowledge management?

References

1. CubeSat Illustration, https://n-avionics.com, accessed 22.03.2019
2. Illustrative photos, https://unsplash.com, accessed 22.03.2019
3. NTNU-photo, https://www.ntnu.edu, access 22.03.2019
4. Sopha, B.M., Fet, A.M., Keitsch, M.M., and Haskins, C. (2010) “Using systems engineering to create a framework for evaluating industrial symbiosis options.” Systems Engineering 13 (2): 149-160.
5. Wall, S. D. (2000) “Use of Concurrent Engineering in Space Mission Design”
6. ESA, Concurrent Design Facility, http://www.esa.int/spaceinimages/Images/2008/03/The_Concurrent_Design_Facility_layout, accessed 25.03.2019

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Thank you for listening

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