RADSAT-SK Lessons Learned

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Small Spacecraft Systems Virtual Institute (S3VI) Community of Practice Webinar Series
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UNIVERSITY OF SASKATCHEWAN

Presentation Overview

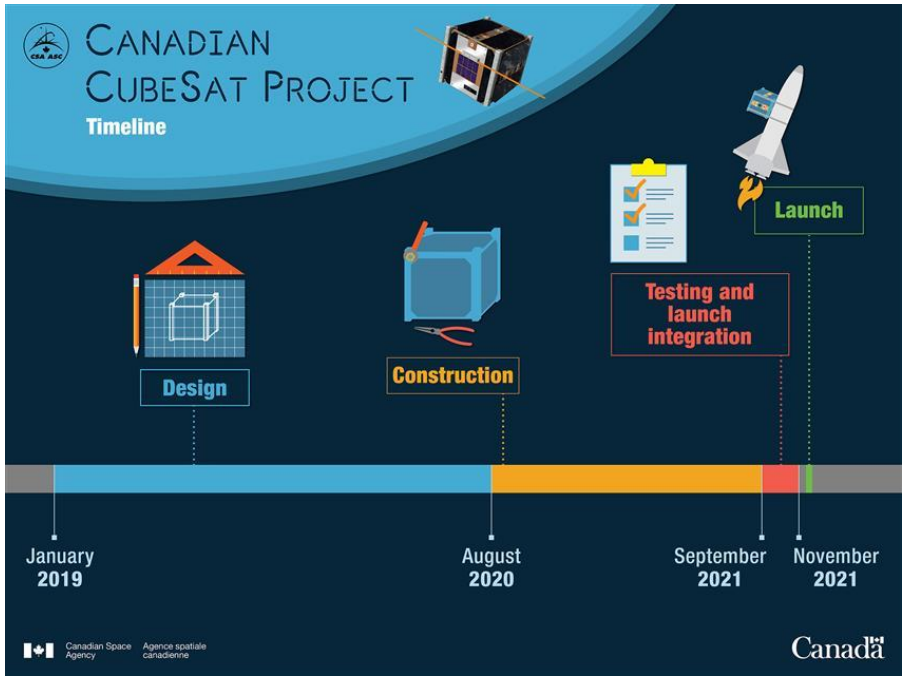
- **A Brief History of RADSAT-SK**
- **Lessons Learned**
  - Design
  - Project Management
  - Student Supervision
- **Summary & Final Thoughts**
- **Acknowledgements**
- **Q&A**

A Brief History of RADSAT-SK

- late 2017
  - Canadian Space Agency (CSA) AOA for Canadian Cubesat Project (CCP)
- mid-2018
  - Notification of Award/Contract
- late 2018
  - Mission Concept Review (MCR)
- late 2019
  - Preliminary Design Review (PDR)
    - RADSAT-SK mission changes to radiation sensor testing, melanin radiation protection testing, and “tourist” camera

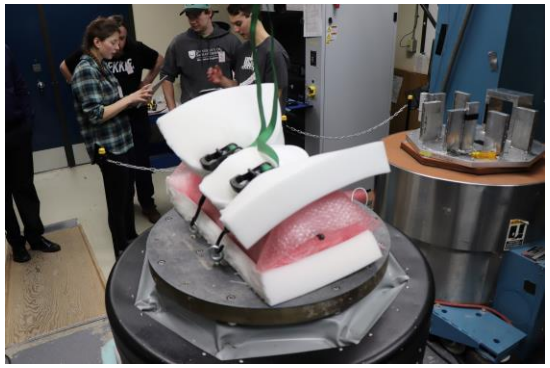
A Brief History of RADSAT-SK

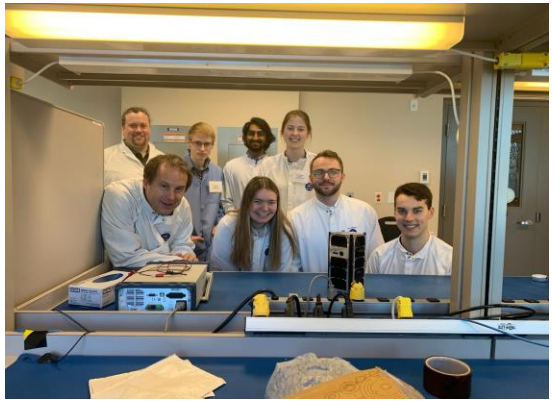
- early 2020 COVID hits
  - building clean room, progress slows
- early 2021
  - Critical Design Review (CDR)
- late 2021
  - Test Readiness Review (TRR), CSA forms 3 batches (we're in Batch 2)
- 2022
  - work intensity ramps up steeply, many problems; we move to Batch 3
  - Flight Readiness Review (FRR) late in year and Batch 1 launches



A Brief History of RADSAT-SK

- early 2023
  - software is the limiter; battery & OBC difficulties too
  - Batch 2 launches
  - final assembly, trouble shooting, abandon camera
  - vibration testing at Calian Advanced Technologies
  - integration at CSA in Montreal (with Nanoracks)



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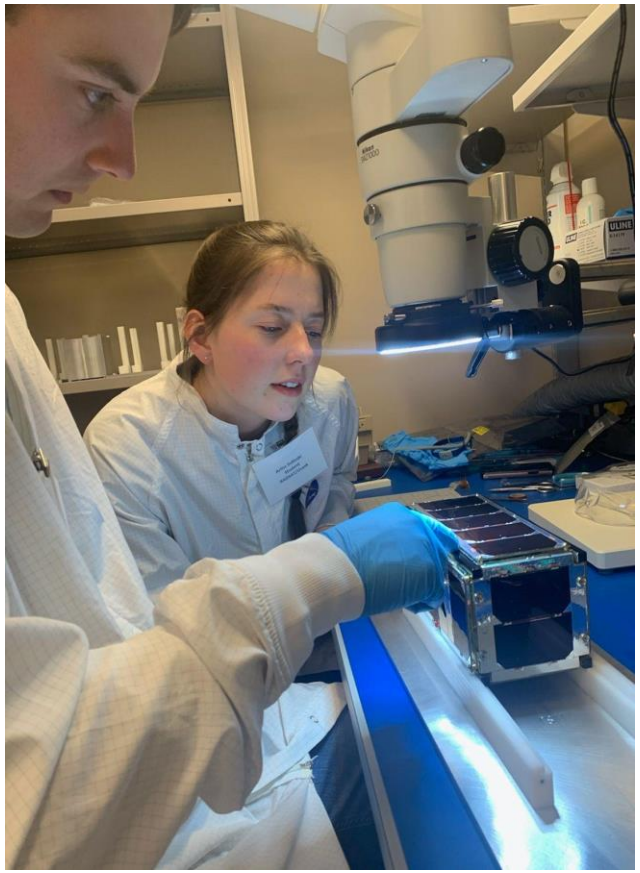
The crew is off to Montreal for integration!!!
RADSAT-SK

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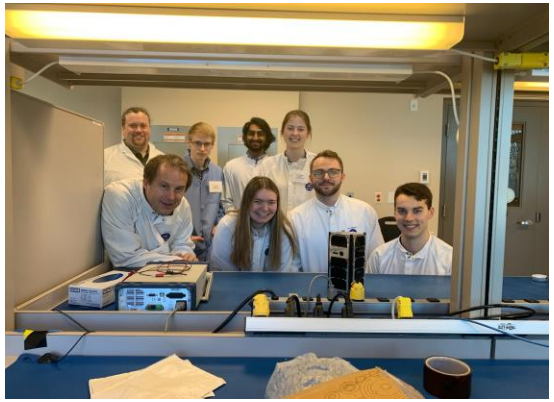
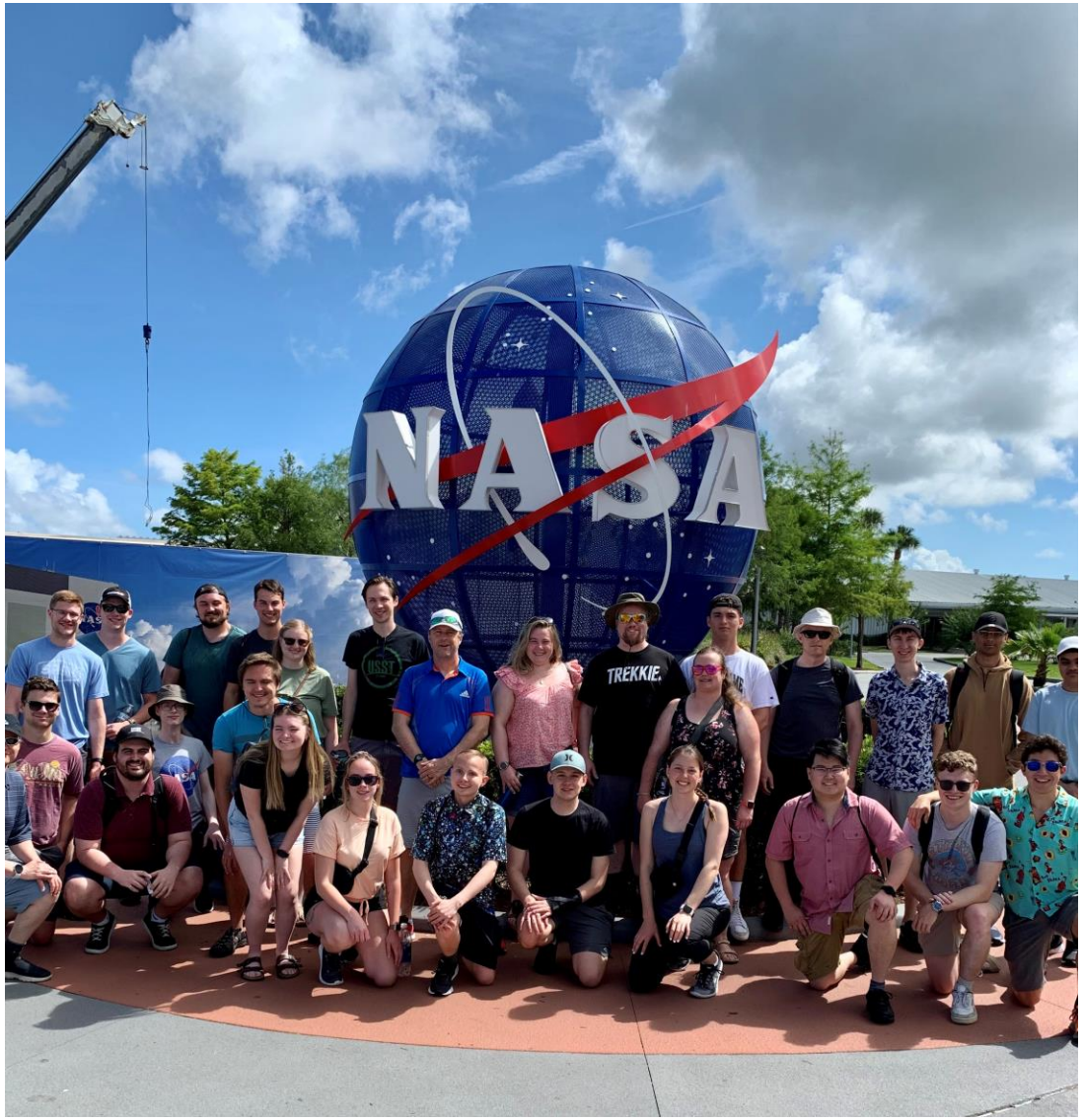
A Brief History of RADSAT-SK

- early 2023
  - software is the limiter; battery & OBC difficulties too
  - Batch 2 launches
  - final assembly, trouble shooting, abandon camera
  - vibration testing at Calian Advanced Technologies
  - integration at CSA in Montreal (with Nanoracks)
- June/July 2023
  - Batch 3 (with us aboard!) launches on SpaceX in FL
  - deployment from ISS, and we get our TLE's

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A Brief History of RADSAT-SK

- last 8 Months of 2023
  - ground station completion (s/w and h/w)
  - ground station testing
- late 2023
  - refinement of ground station s/w and h/w
  - no contact with RADSAT-SK yet
  - Batch 3 orbits decaying (solar max)
  - still trying to talk with RADSAT-SK

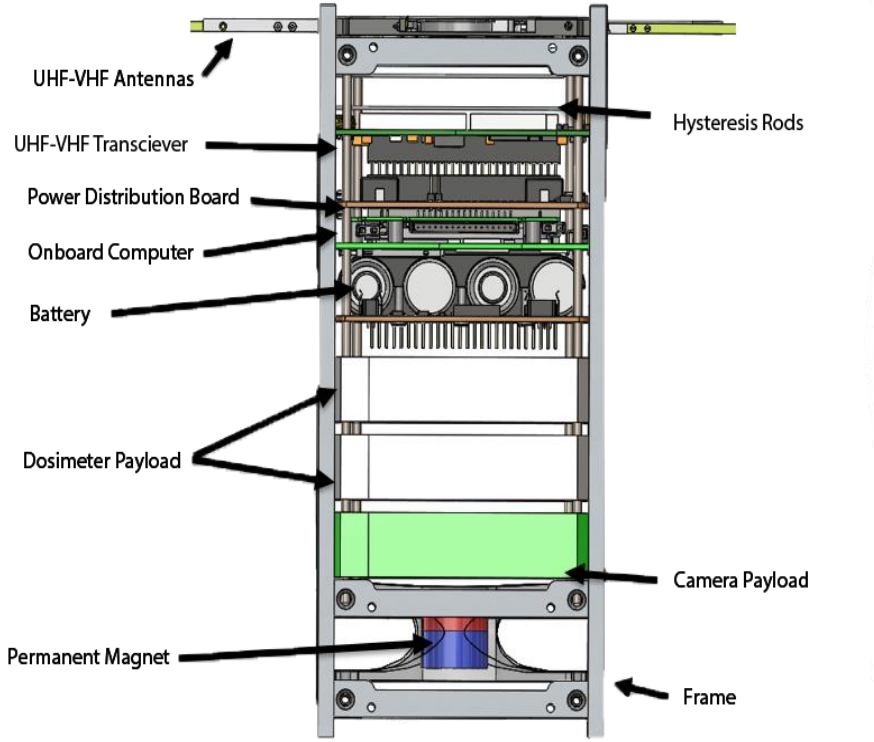
Of Note: A Brief History of RADSAT-SK2

- late 2022
  - Canadian Space Agency AOA for CUBICS
- Winter 2023
  - Notification of Award/Contract
- late 2023
  - Mission Concept Review (MCR)
    - more/better/advanced radiation sensor testing, melanin radiation protection testing, and cloud measurement camera

Lessons Learned - Design

- in no particular order of importance or chronology

1) fail early, fail often
   - fail early and recover
   - fail late and don't
   - fail often to pre-empt surprises

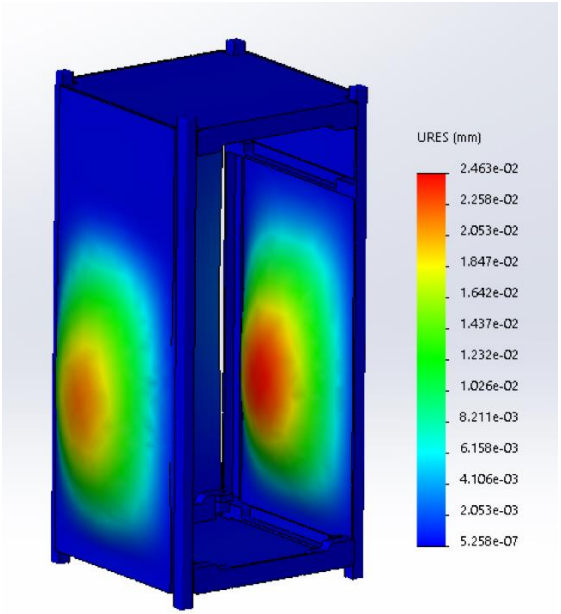


Lessons Learned - Design

2) get references for OEMs
   - find out who has used the equipment that you want to use
   - talk with them
   - value good service

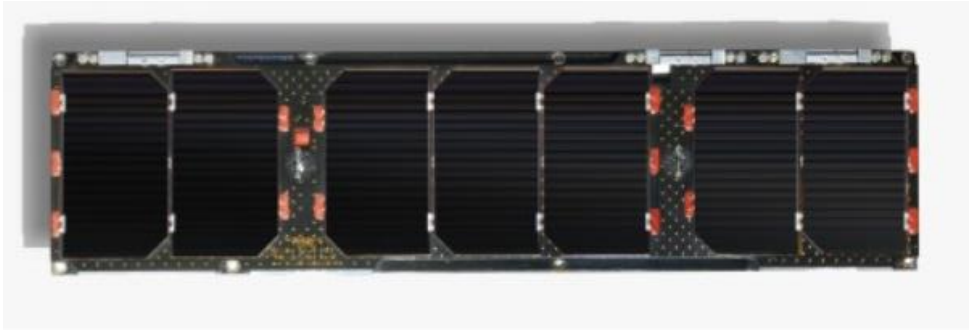
Lessons Learned - Design

3) work at the same design level across systems
   - conceptual → configuration/preliminary → detailed
   - your satellite is a system
   - don't jump ahead to detailed design too fast
   - make sure "parts" fit together every step of the way e.g. our "satellite location" snafu



Lessons Learned - Design

4) carefully choose between OTS and custom
   - CSA goal: HQP development
   - but … success would be nice too … and nothing is easy in space
   - so don't be too ambitious; it'll be hard enough anyways



Lessons Learned - Design

5) beware of too much/little confidence and positive feedback
   - overconfidence just about killed our mission
   - ironically, so did a lack of confidence
   - find the sweet spot
   - initial strong encouragement can lead to sloppiness

USST University of Saskatchewan Space Design Team

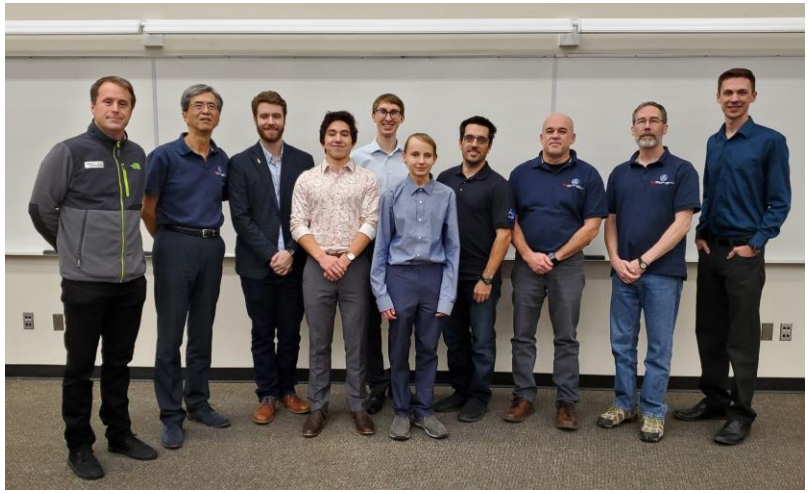
Lessons Learned - Design

6) create a supportive critique culture
   - good critiques = having each other's back/catching each other's errors
   - encourage/teach constructive questioning and critiques

7) talk across (sub) teams
   - ask/encourage (dumb) questions
   - check assumptions
   - talk about technical linkages between teams/sub-systems
   - build it into regular operations, don't save it for special occasions

Lessons Learned - Design

8) host regular mentor/multi-team meetings
   - MCR/PDR/CDR/TRR/FRR all with CSA and other teams; very helpful
   - CSA weekly meetings mid-2022 to integration were HUGELY helpful
   - interaction with CSA mentors and other teams provided technical assistance and normalized progress



Lessons Learned – Project Management

- again, in no particular order of importance or chronology

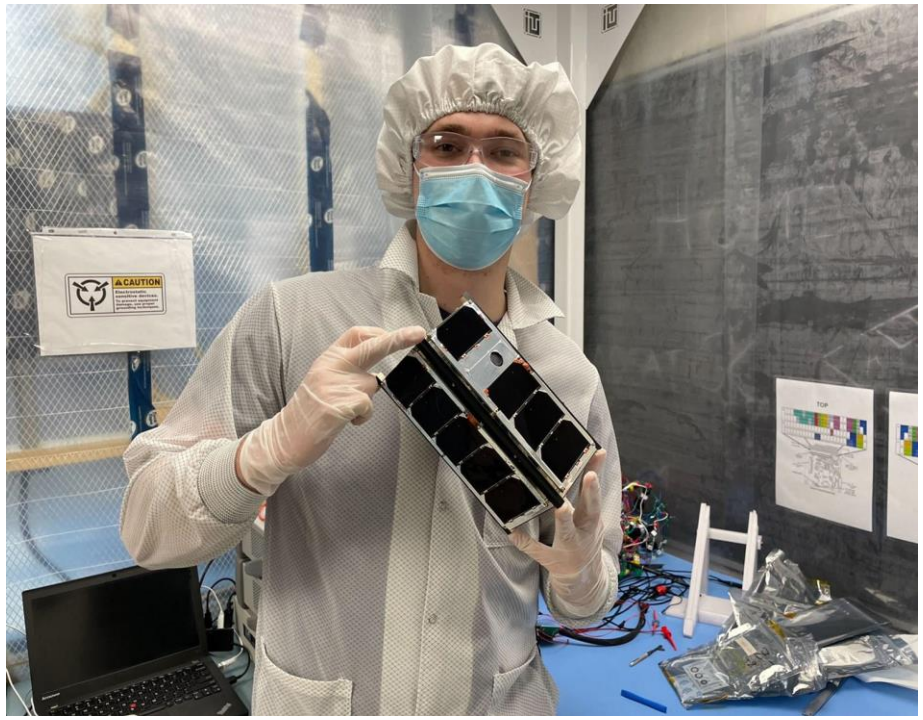
1) invest in succession planning
   - apprenticeship model for all leadership roles
   - co-lead before becoming the lead
   - don’t leave before co-lead is trained
   - include freshmen/juniors in the team

Lessons Learned – Project Management

2) recruit, orient, and train
   - always be recruiting by multiple means
   - provide orientation to new team members so all are on same page
   - train them for their role(s) and provide training opportunities

Lessons Learned – Project Management

3) maintain healthy sub-teams
   - don't let sub-teams get too small
   - don't let them get too homogenous e.g. all same year (or discipline)
   - diversity (age, gender, discipline) in membership will create resilience

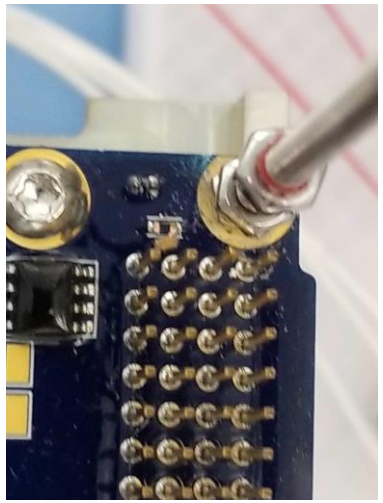


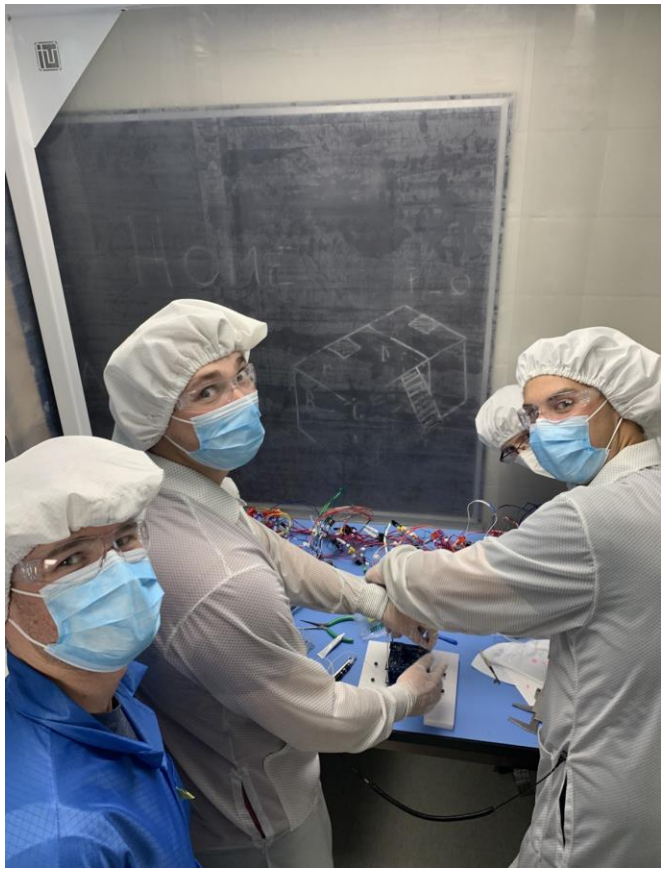
Lessons Learned – Project Management

4) the three legs of finances
   - fundraising, budgeting, accounting
   - very different skill sets
   - get someone to lead each

Lessons Learned – Project Management

5) accelerate progress with summer students
   - volunteers can be challenging to manage
   - augment with summer/PT paid positions
   - it accelerates progress and builds skills



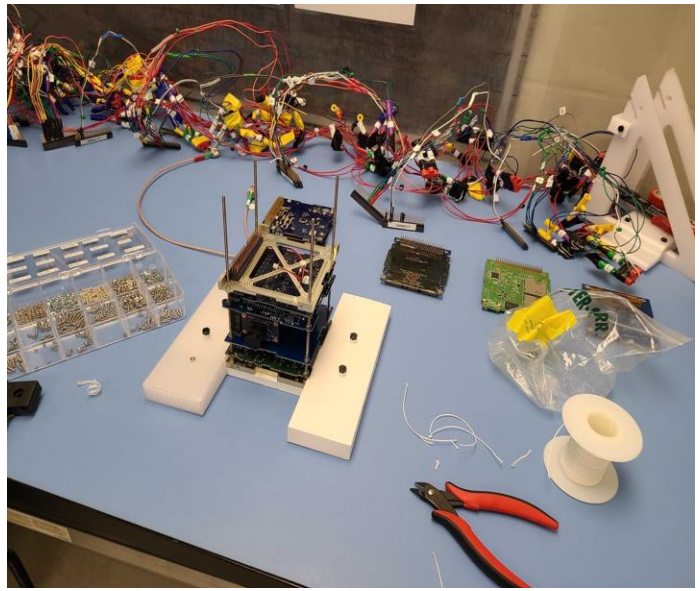
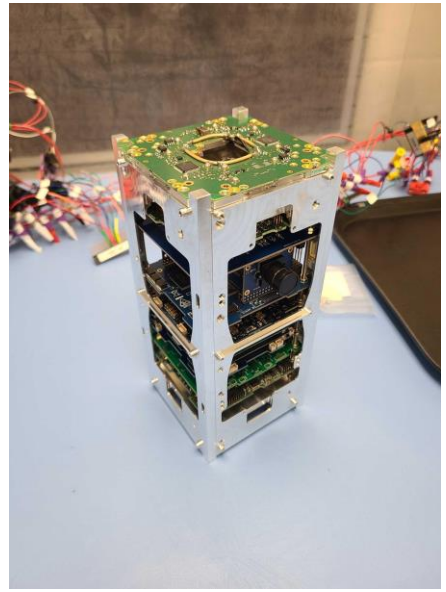


Lessons Learned – Project Management

6) don’t neglect the ground segment
   - have ground station ready pre-launch
   - else risk large loss of momentum
   - testing (as always) takes time
   - mission doesn’t end with launch

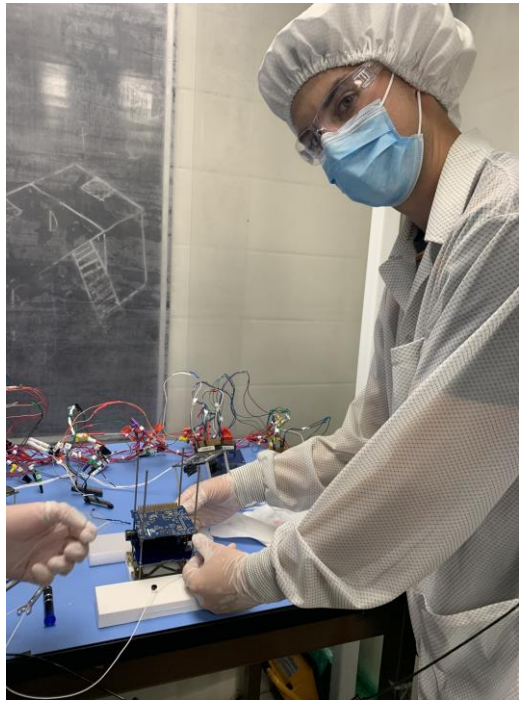
Lessons Learned – Project Management

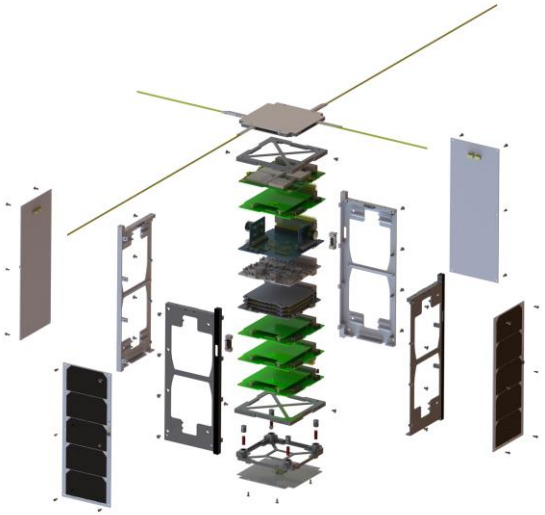
7) if you do one cubesat, plan for a second
   - you've built up experience, licenses, infrastructure, and a support network … leverage it forward

Lessons Learned – Project Management

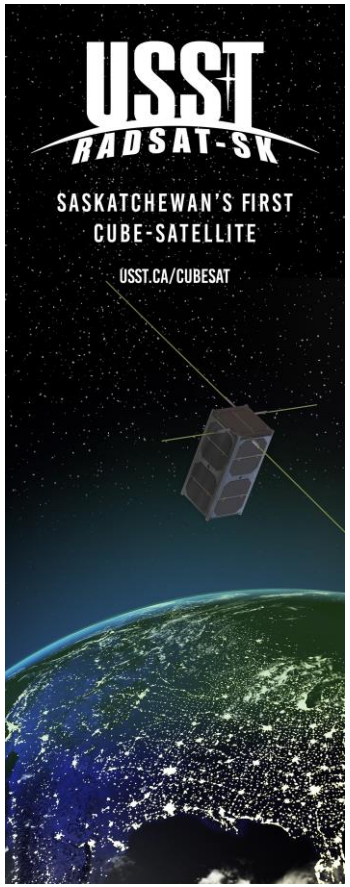
8) you can work around COVID
   - depends on what phase of development you're at though
   - hand-offs of equipment
   - online/remote meetings
   - trade code, files remotely
   - supplier delays can be hard
   - fight to sustain momentum





Lessons Learned – Project Management

9) non-technical activities are important/vital
   - celebrate milestones (reviews)
   - have social events
   - distribute the spotlight




USST
SPACE DESIGN TEAM
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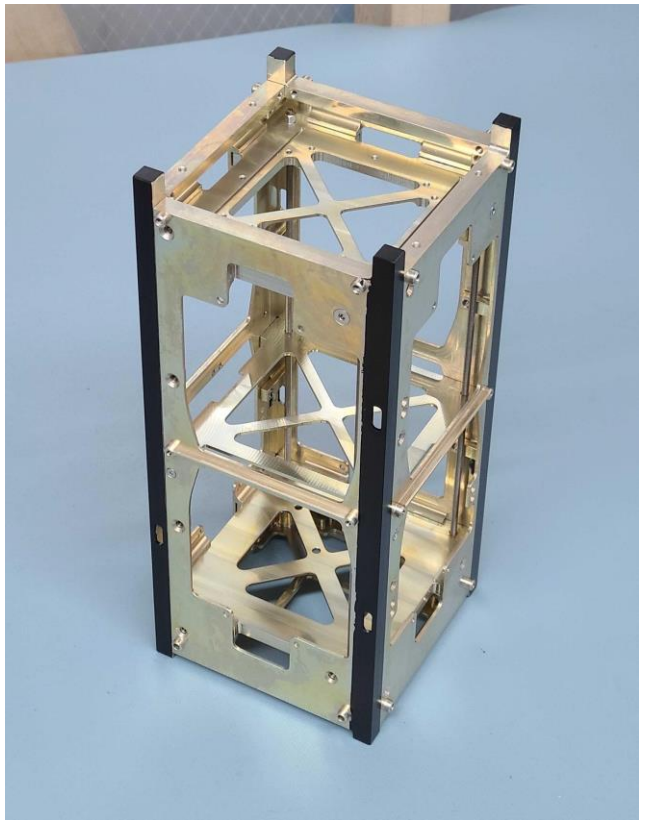
RADSAT-SK
CUBESAT

Lessons Learned – Project Management

10) approach academic tie-ins with caution

- conflicts of interest will often occur
- academic and project schedules rarely match
- team buy-in can be compromised
- if carefully managed, it can boost progress



Lessons Learned – Student Supervision

- let them do all the technical work (they can do it, with help)
- they will need your help with bureaucracy/logistics/project mngmnt
- have a tech PM, a financial PM, and an HR/PR PM (3 in total)
- interview, and retain final say on, all PM “hires” (and fires)
- weekly PM meetings are worthwhile, pre-launch
- make sure you show your face to the whole team periodically
- like the students, have a co-lead(PI), who will take over eventually

Summary

- **Design**
  1) fail early, fail often
  2) get references for OEMs
  3) work at the same design level across systems
  4) carefully choose between OTS and custom
  5) beware of too much/little confidence and positive feedback
  6) create a supportive critique culture
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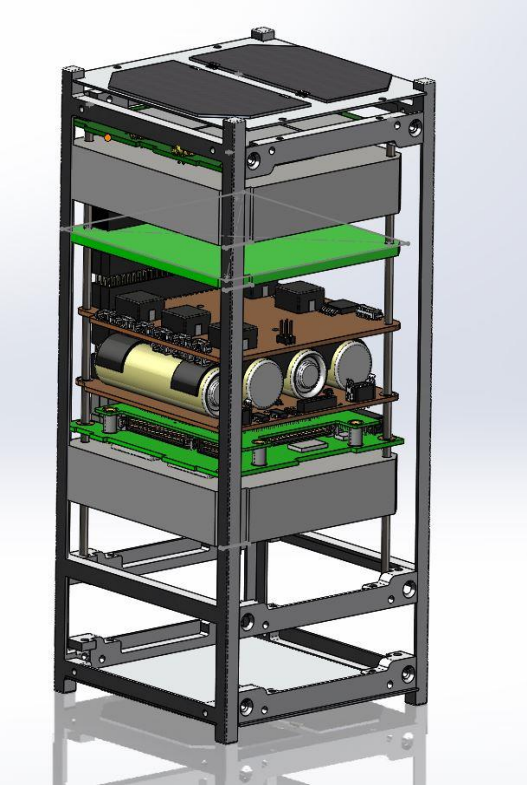

Summary

- **Project Management**
  1) invest in succession planning
  2) recruit, orient, and train
  3) maintain healthy sub-teams
  4) the three legs of finances
  5) accelerate progress with summer students
  6) don’t neglect the ground segment
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  8) you can work around COVID
  9) non-technical activities are important/vital
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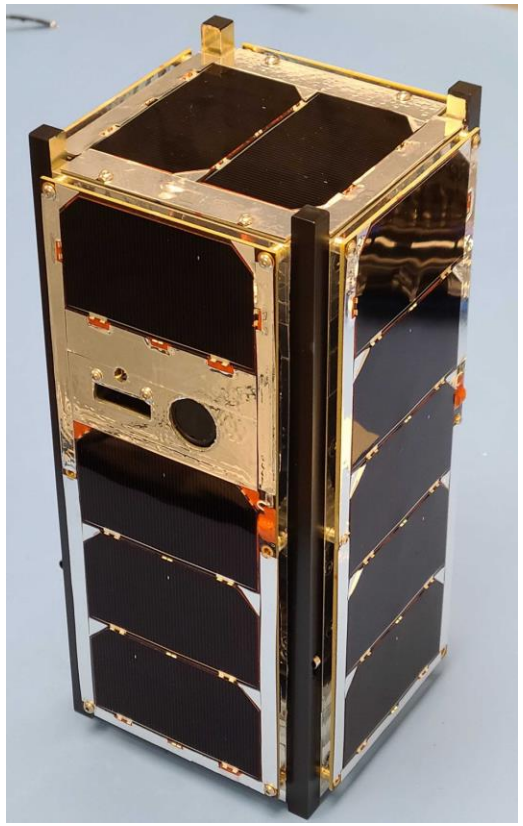

Final Thoughts

- satellite design is unforgiving
- what's most important to remember?
  - everything
- don't be too ambitious
  - assume anything that can go wrong, will; and plan for that
- supported undergrads can do it

Acknowledgements

RADSAT-SK was made possible by …

- the Canadian Space Agency and its great CCP staff, the USask College of Engineering, Sask Polytech, and our generous private donors
- all students who were members of the RADSAT-SK Team (especially the Team Leads and Project Managers)
- Drs. Brian Berscheid, Li Chen and Kate Dadachova
- Calian Advanced Technologies, Galaxia Mission Systems

University of Saskatchewan

Thank you for your attention

Any Questions?