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Project Changes (1)

- Switch to EnduroSat platform
 - Funding conditions of the Swiss Space Office for ESA PRODEX Programme
 - Reduce risk for sponsors
- SSO will finance scientific payloads if we finance the platform and launch
- Greatly reduced risk of platform failure, development time and costs
- Lost track of main educational objectives
- Partners got kicked out of CHESS

Project Changes (2)

- Need to start from requirements, reevaluate previous decisions
- Initial project changes turned out infeasible due to lack of space
 - Needed more precise estimates, chicken & egg with EnduroSat
 - Eventually settled with budgets, waited too long (Valispace)
- Late payload modifications
- Seems like we have a reasonable compromise on objectives
 - Exactly how good will depend on testing plan
 - Shipment of subsystems on its way



Subsystem	Size				Weight		Power (in most consuming mode)			
	Height [mm]		Width [mm]	Length [mm]	Mass [kg]		Average [W]		Peak [W]	
EOBC (no GNSS)	14.4	5%	89.0	93.9	0.130	5%	0.64	inc.	0.73	inc.
EPS	70	5%	90.2	95.7	1.050	5%	0.07	inc.	0.07	inc.
ADCS	75	5%	90.0	96.0	0.554	5%	1.02	inc.	4.25	inc.
UHF	11	5%	89.0	95.0	0.090	5%	2.64	inc.	2.64	inc.
XBand	22.5	5%	90.2	95.9	0.275	5%	6.20	inc.	9.00	inc.
TOF	100	8%	90.2	95.9	1.000	10%	7.06	inc.	9.00	inc.
GNSS	25	8%	89.0	95.0	0.150	20%	0.20	inc.	1.00	inc.
HOBC	15	8%								
STRUCT	340.5	-3%	100.0	100.0	0.340	5%	1.00	inc.	2.00	inc.
ENV Nav Satellites	N/A		N/A	N/A	N/A		N/A		N/A	
GS - Human - Stakeholders	N/A		N/A	N/A	N/A		N/A		N/A	
Total	353.745	mm			3.841	kg	OPERATION MODE DEPENDENT			
	CAREFUL				SEEMS FINE		RECAP TABLE SEEMS FINE			

Figure 2.2: High level SWaP (size, weight and power) budget preview.

Trade Offs → Key factor: 3U height

- EnduroSat platform is bulkier than previous design
- ADCS precision .vs. EPS battery capacity
 - Guided by requirements, affects ConOps
- Payload
 - RA transponder replaced by in house OBC (simplified from original)
- Communications → New pole
 - Amateur .vs. Commercial frequencies
 - Xband Transmitter by HSLU .vs. EnduroSat
 - Xband Antenna
 - Ground Station options

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Systems Engineering

- Reorganized information
- Reviewed requirements to match EnduroSat COTS modules
- Established budgets
- Redefined ConOps
- Renewed architecture and interfaces
- Nothing fixed by contract → MOU...

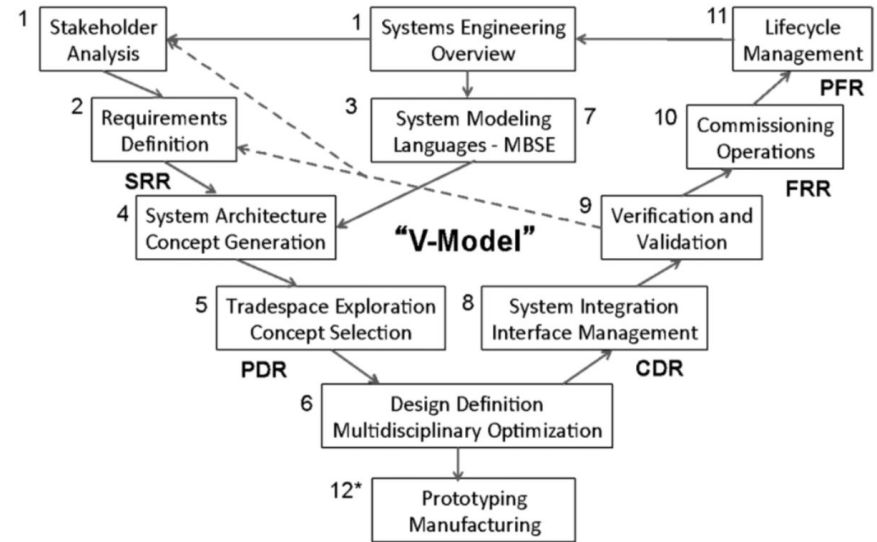


Figure 2.1: V-model development cycle in systems engineering [44] and stages where major reviews usually take place.

How we worked

- Tasks assigned to credited students by theme of project (interfaces)
 - Weekly meetings to discuss progress
- Other tasks selected by association students
 - 1 month to familiarize with the project and for us to figure it out, then,
 - Weekly in person meetings to discuss each other's work

Architecture

- Redundant multi-master instead of centralised system
 - Better failure management
- Redundant power supply
 - Multiple pins and EPS channels internally
 - No solution to looping concerns raised by Spacetek CEO
- Redundant communication option
 - Just reached consensus on platform connections with EnduroSat
 - Pin choice left for payloads
 - Cannot easily add communication pins – EOBC MCU vs FPGA
 - Payloads could connect to EOBC through other pins/protocols

Interfaces

- Project coordination / Human
 - Restructured CHESSE towards testing
 - Information better organized & referenced, comprehensive report (hopefully)
 - Key numbers in Valispace (and spreadsheets)
 - Email conversations forwarded to contact.chesse@epfl.ch
- Mechanical / Environmental / Thermal
 - CAD and Simulations
- Electrical and Communications
 - PC104 connector
- Operational
 - ConOps software



Subsystem	EOBC	EPS	ADCS	UHF	XBand	TOF	GNSS	HOBC	STRUCT	ENV Nav Satellites	GS - Human - Stakeholders
EOBC											
EPS											
ADCS											
UHF											
XBand											
TOF											
GNSS											
HOBC											
STRUCT											
ENV Nav Satellites											
GS - Human - Stakeholders											

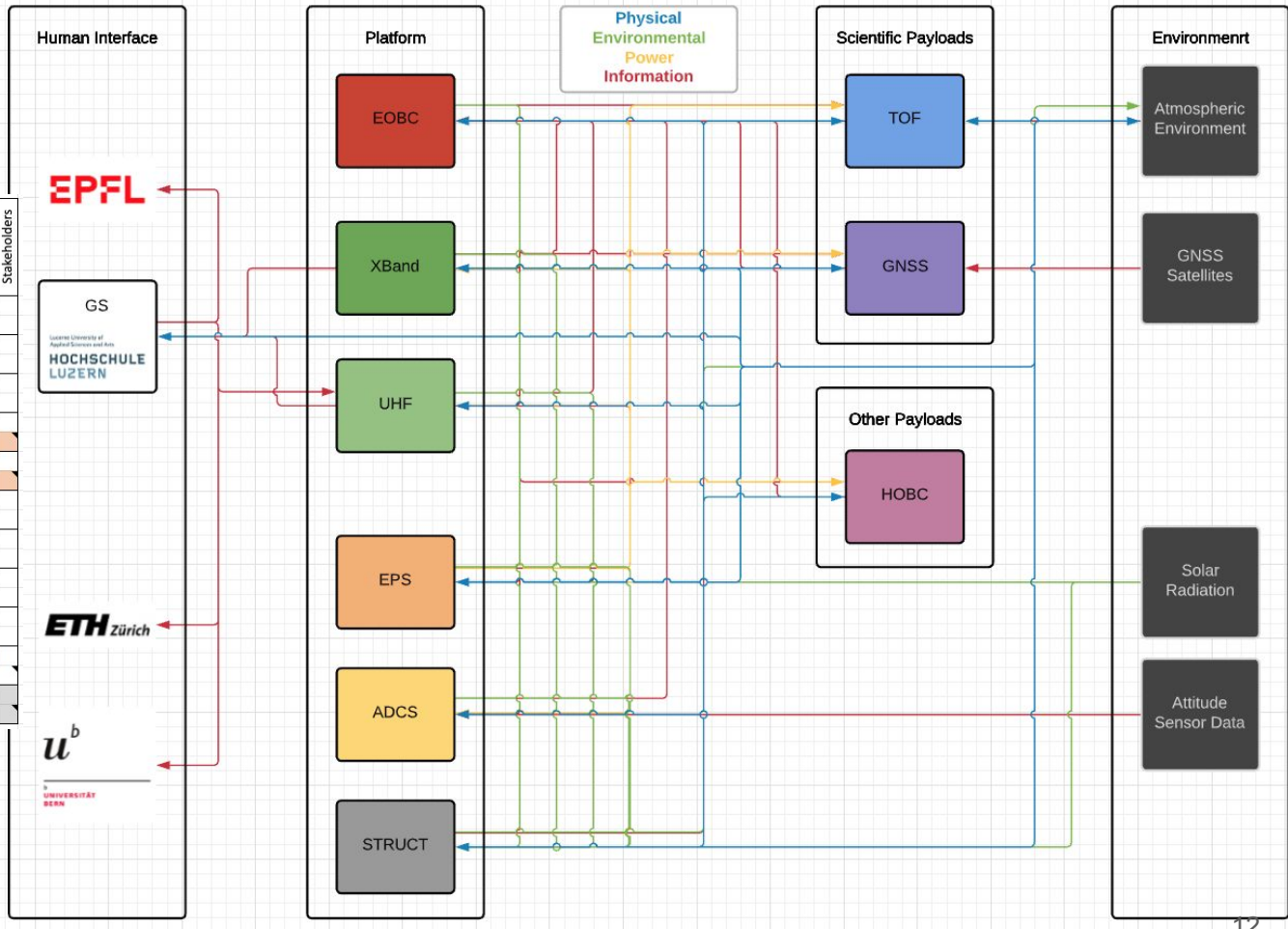


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Next steps

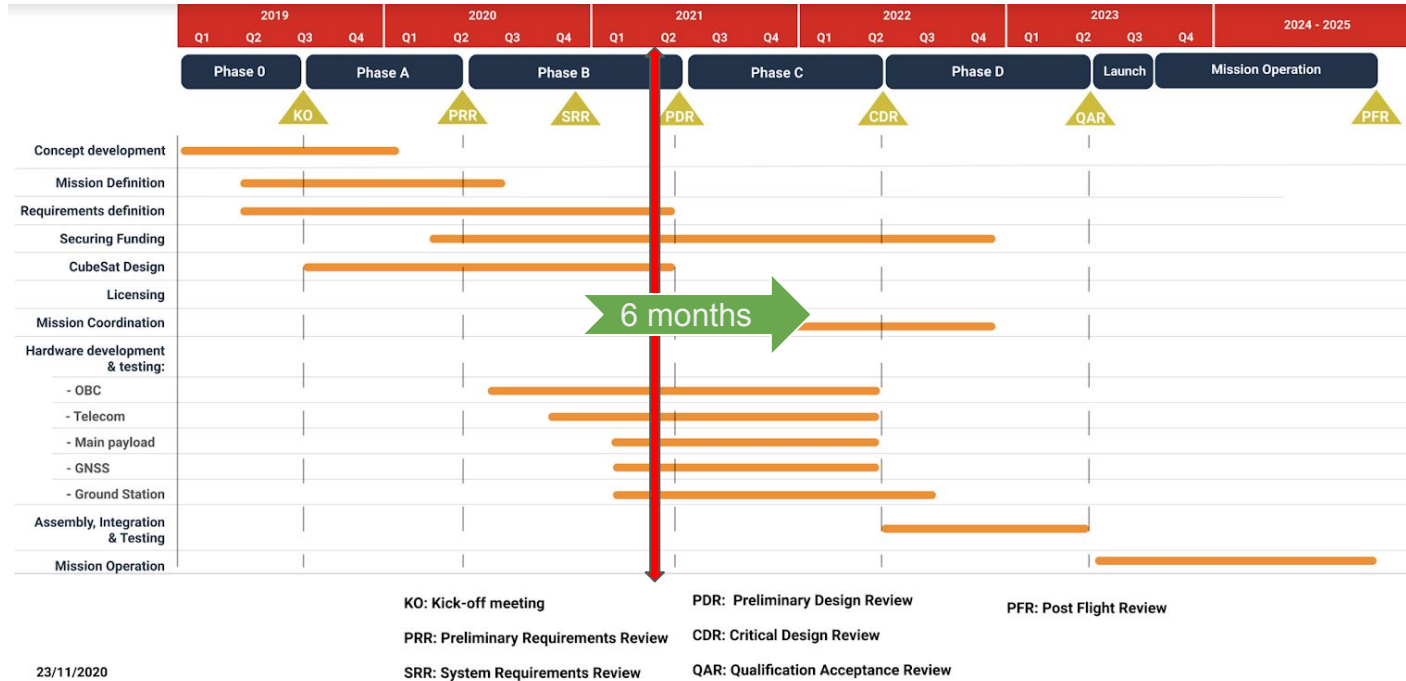
- EnduroSat awaiting CAD of HOBC and Xband antenna to propose assembly
- Prepare Preliminary Design Review (PDR)
- **Merge ConOps with architecture and budgets** – Validate with EnduroSat
- **Test subsystems** separately and plan integration
 - Verify individual requirements
 - Validate functionality
 - Anticipate logistics issues
- Perform risk assessment and mitigate anticipated issues
- Recruitment

Timeline

- SDR - November 2021: Talk through the existing design, ConOps, interfaces with the payload engineers (and EnduroSat), refine the existing baseline
- PDR - January 2022: “Demonstrates that the preliminary design meets all system requirements with acceptable risk and within the cost and schedule constraints and establishes the basis for proceeding with detailed design”
- ...
- Gives us some time to find some sponsors

See Appendix J & K of the NASA Handbook

EnduroSat platform ready - mostly delayed due to funding



23/11/2020

Timeline presented last semester

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Criticism (—)

- Repercussions from financial decision on the mission
 - Areas of change well anticipated but slow to act
 - Could have helped to involve partners in decision from the start
- EnduroSat datasheets are a mess (they are still updating them...)
 - Tried to solve problem myself first - project goal after all
 - Took too long to contact them,
 - Could have spent some time defining what information flows through which line (PC104)
- Did not learn much about MBSE on my free time in the end
- SE is a big learning curve for most 1st year students
 - Not enough time to invest to keep pace
 - Not aware enough to “think SE”, requires some engineering basics
- Supervision meetings diverged to discuss association matters too often
 - Important questions but maybe not the place/time

Criticism (+)

- Good job at maintaining information traceability
 - References to data source
 - Possibility of a wiki to reference problems/solutions as well
- Work and meeting minutes documented weekly
 - Progress tracking and accountability
- Satellite is now unlikely to change
 - Worst case scenario we anticipated – remove HOBC
 - Maybe an antenna placement issue (UHF, Xband, GNSS) – see with CAD
- Better contact with partners
- Project is back on a good track after a rocky semester
- Concluded with IAF competition application for a free satellite launch
 - Hope to present CHESS at the International Astronautical Congress in Dubai

References

[Autumn 2020 Presentation](#)

[CHESS Renovation Report](#)

To do

Transfer power budgets onto Valispace, with modes etc. (need to check numbers)