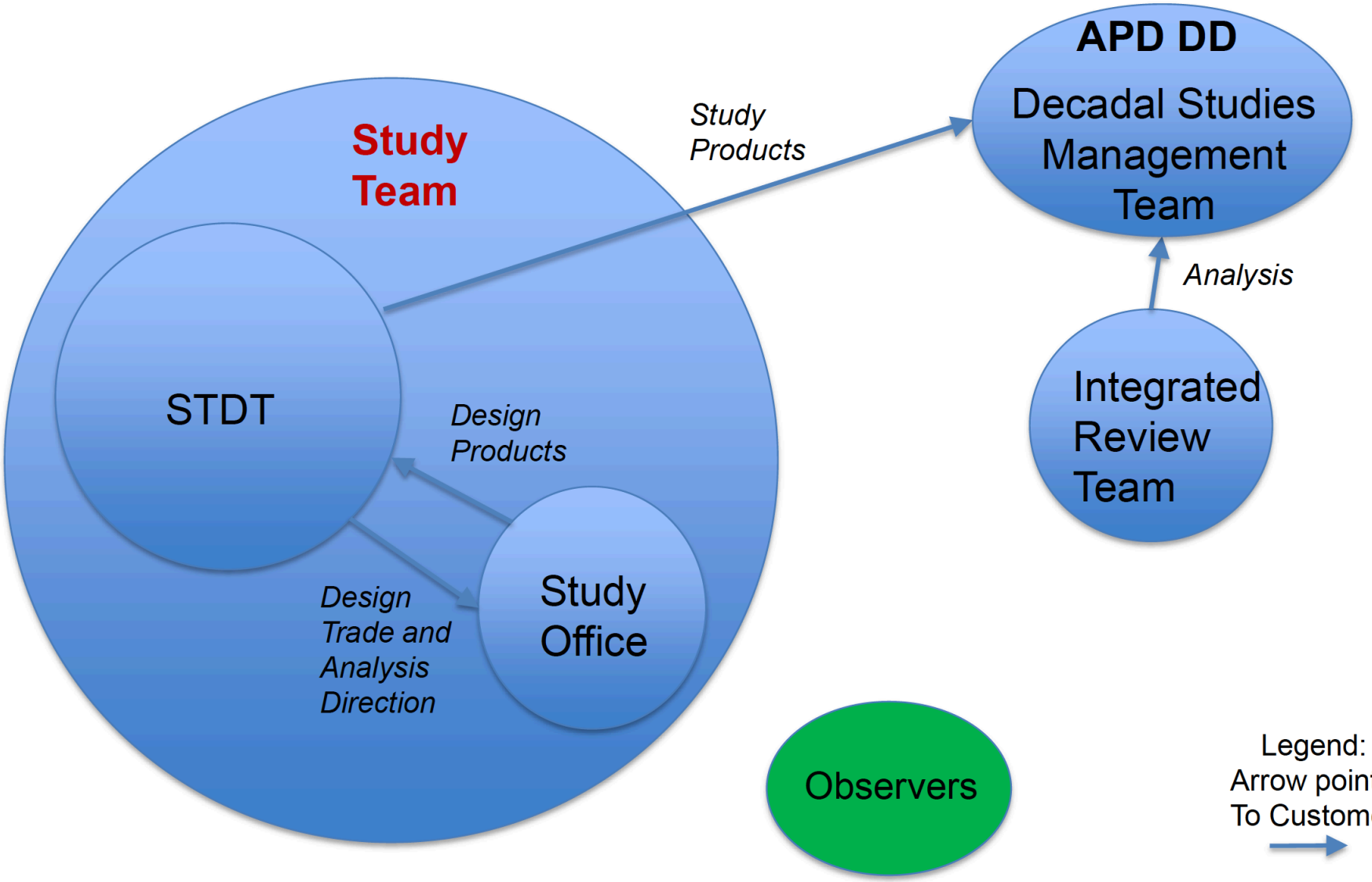
Study Plan and Schedule

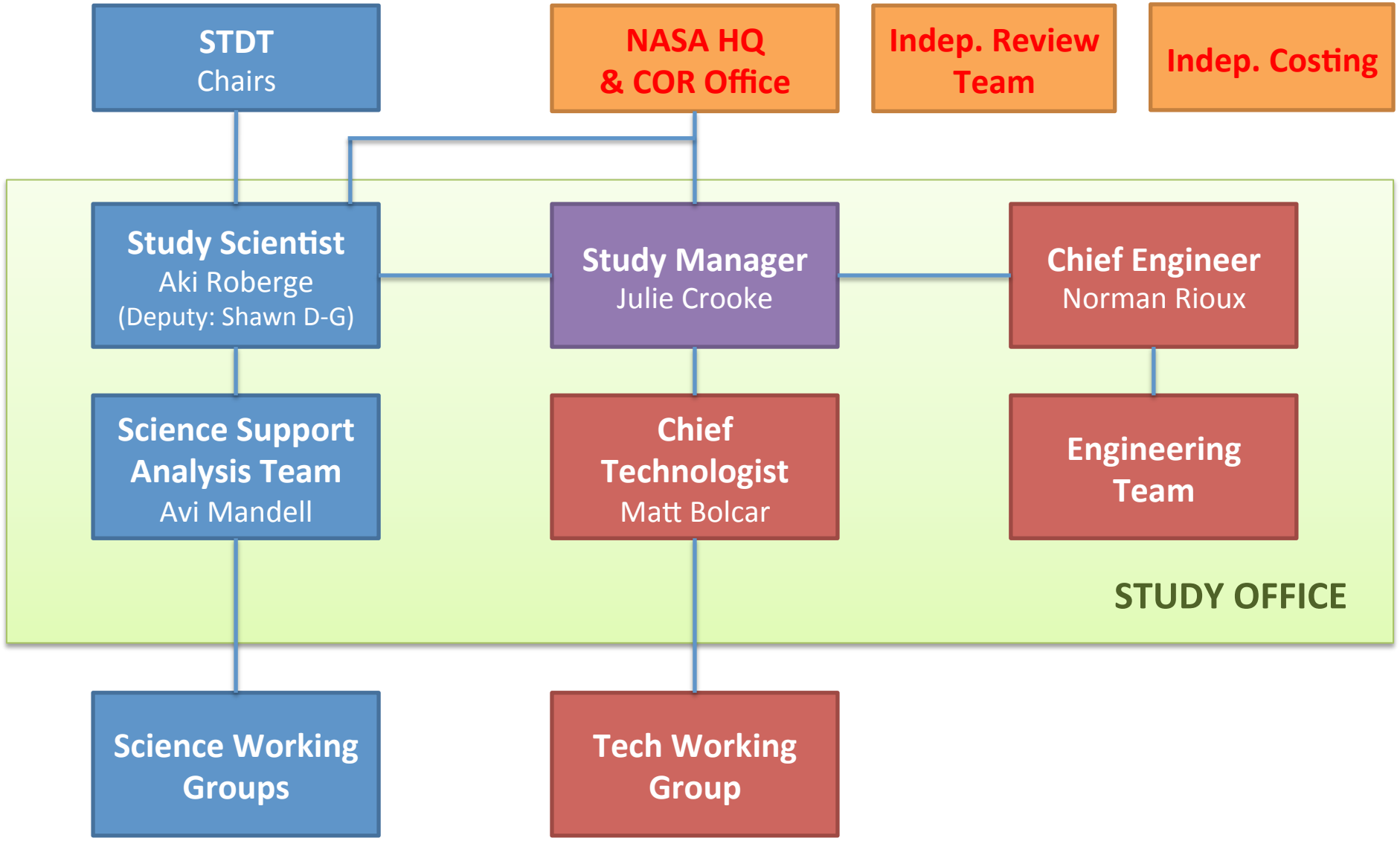
May 10, 2016

Roles and Responsibilities: A Team and Customer View

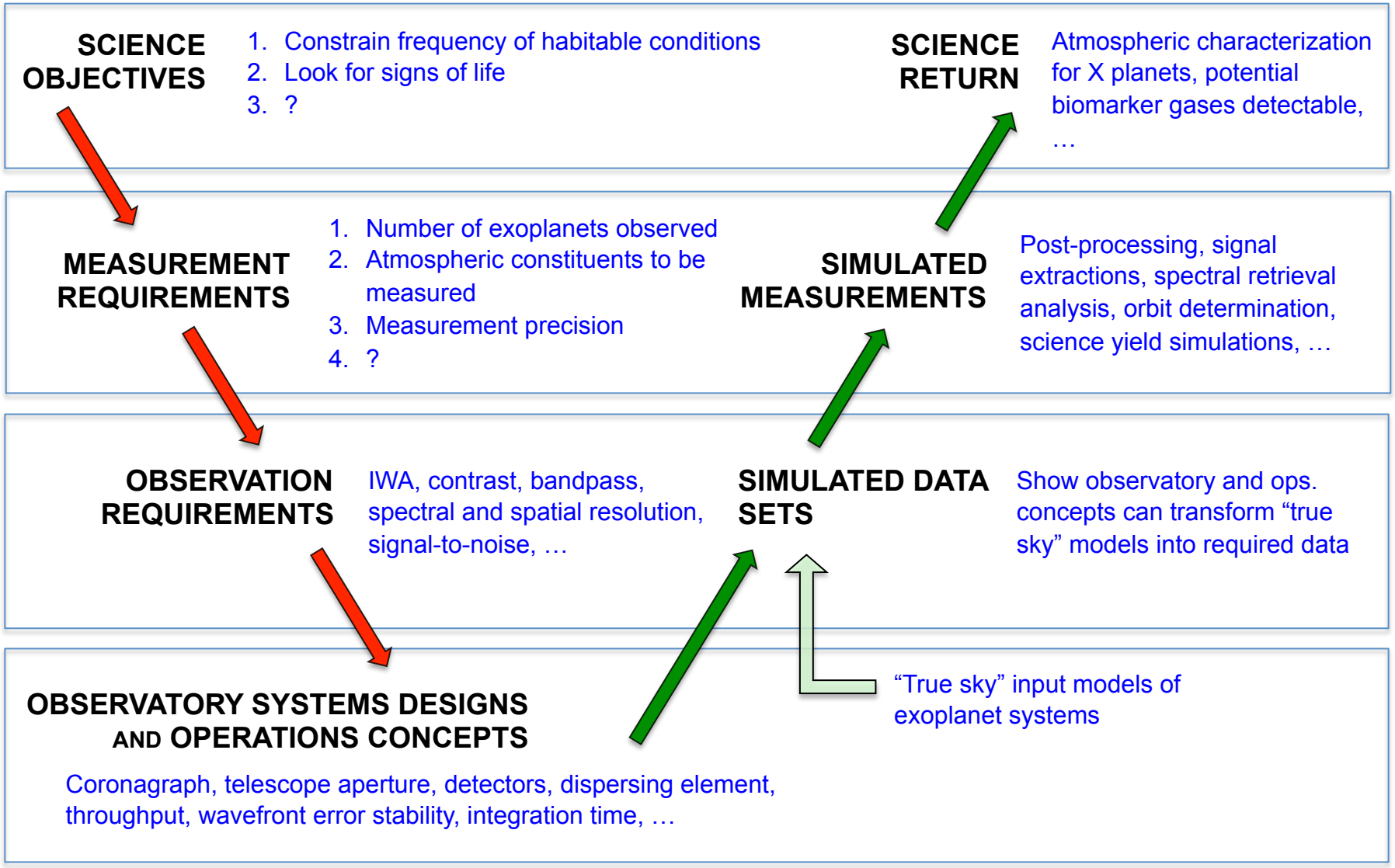
ExoPlanet Exploration Program



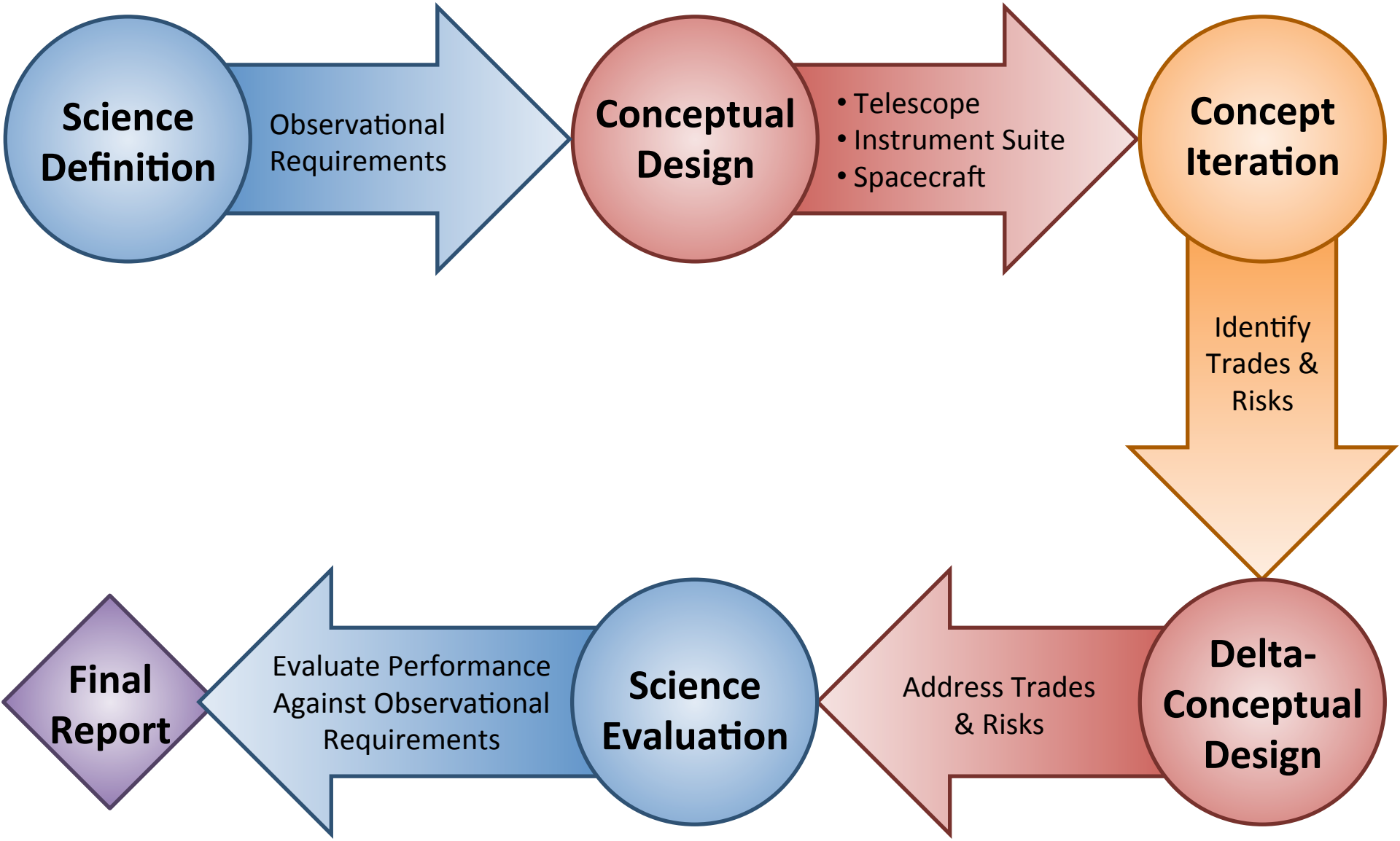
LUVOIR Org Chart and Reporting



Science – Engineering Interaction
Example : ExoEarth Direct Observations

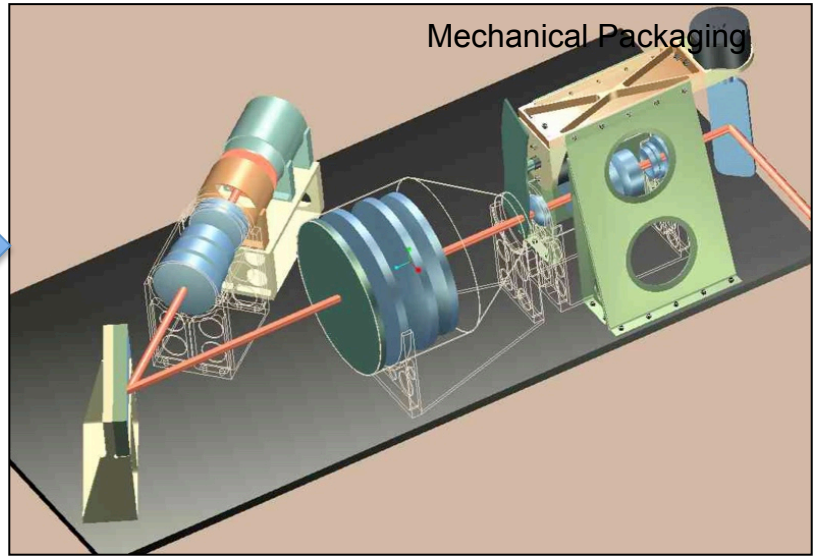


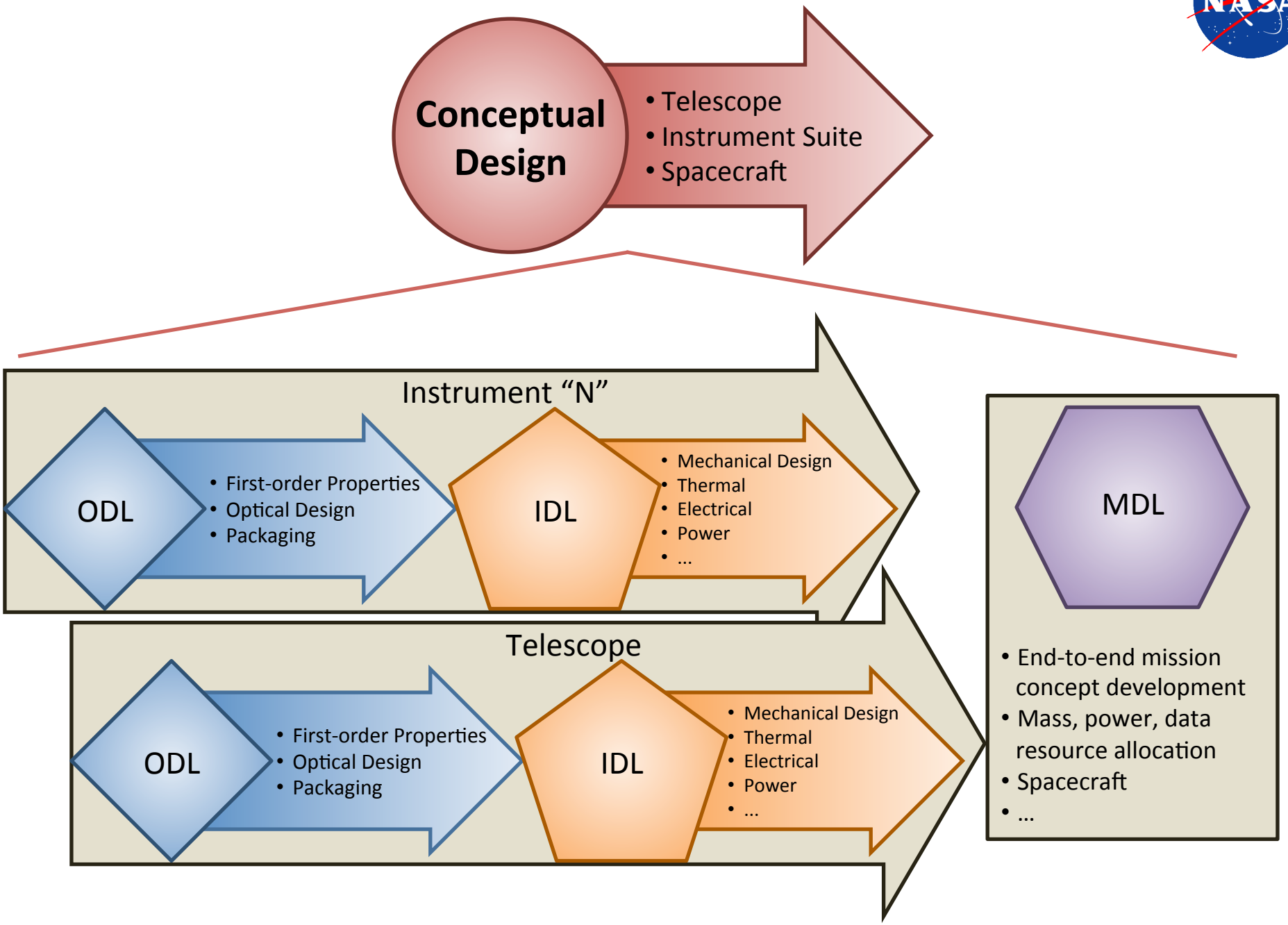
OBSERVATORY SYSTEMS DESIGNS AND OPERATIONS CONCEPTS



What is the IDC?

- IDC: Integrated Design Center, which includes
  - Optical Design Lab (ODL)
    - Offering optical design and analysis
  - Instrument Design Lab (IDL)
    - Offering conceptual design and analysis of instrument systems
  - Mission Design Lab (MDL)
    - Offering conceptual end-to-end mission design and analysis




Conceptual Design
• Telescope
• Instrument Suite
• Spacecraft
Instrument "N"
ODL
• First-order Properties
• Optical Design
• Packaging
IDL
• Mechanical Design
• Thermal
• Electrical
• Power
• …
Telescope
ODL
• First-order Properties
• Optical Design
• Packaging
IDL
• Mechanical Design
• Thermal
• Electrical
• Power
• …
MDL
• End-to-end mission concept development
• Mass, power, data resource allocation
• Spacecraft
• …

What does the engineering team need from the STDT?

- Foundation for conceptual design is the science objectives, measurement and observational requirements
  - Engineering development proceeds in parallel due to short study timeframe for Decadal
  - Engineering conceptual design is subject to revision based on STDT's evolving understanding of science objectives and overarching science needs
- Dialog and analyses at appropriate levels over the course of the study to carry out the process shown in the Science – Engineering Interaction chart
- Key engineering parameters driven by science needs
  - For example: wavelength range, resolution, sensitivity, field of view, sampling, etc.

What the engineering team will deliver back to STDT?

- Engineering performance estimates against the science needs and parameters
- Questions about science needs and parameters that surfaced through the engineering conceptual design effort
- Identification of science needs and parameters that critically drive the design and opportunities for further refinement or trades
- Improved conceptual design based on science feedback to design process

Interaction with Aerospace

- Aerospace provides an independent perspective on costs and risks that can be used as feedback for the mission formulation process.
  - Study Office will collaborate with Aerospace to obtain their insights on cost and risk elements and perform technology and engineering trades

- Aerospace to provide an independent cost estimate

When?

- Schedule

ExoPlanet Exploration Program

Study Deliverables

All products delivered to APD Deputy Division Director

M1	**Comments on Study Requirements and Deliverables** – Accept the study requirements/deliverables and submit plan--- or – Provide rationale for modifying requirements/deliverables	**April 29 2016[1]**
O1	***Optional: Initial Technology Gap Assessment*** – *To impact PCOS/COR/ExEP 2016 technology cycle*	**June 30 2016**
M2	**Detailed Study Plan** – Document starting point CML – Deliver detailed study plan for achieving Decadal CML – Deliver resource required to meet the deliverables for the study duration – Deliver schedule to deliver milestones	**August 26 2016**
M3	**Complete Concept Maturity Level 2 Audit** – Identify, quantify and prioritize technology gaps for 2017 technology cycle	**February 2017[2]**
O2	***Optional: Update Technology Gap Assessments***	**June 2017**
M4	**Interim Report** – Substantiate achieving Concept Maturity Level 3 – Deliver initial technology roadmaps; estimate technology development cost/schedule	Early **Dec 2017[2]**
M5	**Update Technology Gap Assessments** – In support of 2018 technology cycle	**June 2018**
M6	**Complete Decadal Concept Maturity Level 4 Audit and Freeze Point Design** – Support independent cost estimation/validation process	**August 2018**
M7	**Final Report** – Finalize technology roadmaps, tech plan and cost estimates for technology maturity	**January 2019**
M8	**Submit to Decadal**	**March 2019**

[1]APD will provide final study requirements by May 2016 (see "Near Term Activities")
[2]Timed to influence following NASA budget cycle

Schedule Options

	FY16			FY16			FY17			FY17			FY17			FY17			FY18			FY18			FY18			FY19			FY19		
	CY16			CY16			CY16			CY17			CY17			CY17			CY17			CY18			CY18			CY18			CY19		
		Q3			Q4			Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4			Q1			Q2	
DELIVERABLES	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
IDC Runs Option 1					IDC for SLS: 9 mo: Tel, 5 instr, S/C									IDC 5m fairing: 7 mo: (Tel, 3						IDC Delta Run															
IDC Runs Option 2							IDC for SLS: 9 mo: Tel, 5 instr, S/C													IDC Delta Run														
IDC Runs Option 3							IDC for SLS: 9 mo: Tel, 5 instr, S/C							IDC 5m fairing: 7 mo: (Tel, 3 i																					
IDC Run Option 4										IDC for LV_X: 9 mo: Tel, 3-5 instr, S/C																										
HQ Milestones:																																			
M1: Comments	M1																																		
O1: Technology Gap			O1																																
M2: Detailed Study Plan					M2																														
M3: Complete CML2 Audit											M3																								
M4: Interim Report																				M4															
M5: Update Technology Gap Assessments																									M5										
M6: Freeze Point Design and CML4 Audit																													*M6*						
M7: Final Report																																M7			
M8: Submit Report to Decadal																																			M8
Pre-Planning																																			
Technology Reports																																			
CML Audits, DRM, Reports																																			

O1 Deliverable: Technology Gap List

- Report from tech splinter session (Matt)

Back-Up

IDL – Services and Capabilities

Services:

- End-to-end instrument concept development
- Existing instrument/concept architecture evaluations
- Trade studies and engineering evaluations
- Technology, risk, and independent assessments
- Requirement refinement and science traceability
- Mass, power, data resource allocation
- Vendor RFQ evaluation
- Cost estimation

Capabilities:

- Conceptualize instruments that make measurements at wavelengths across the entire electromagnetic spectrum, including x-ray, gamma ray, ultra-violet, visible, infrared, and microwave instruments
- Address instrument families ranging from telescopes, cameras, lidars, spectrometers, polarimeters, coronographs, radiometers, mass spectrometers, etc.
- Model various flight environments, including LEO, GEO, libration, retrograde, away, lunar, deep space, and planetary orbiters, landers, and probes
- Realize instruments for different flight platforms, including space station, balloon, sounding rockets, and UAV instrument design environments
- Consider non-distributed and/or distributed instrument systems as well as robotic servicing, planetary rovers, and sample return

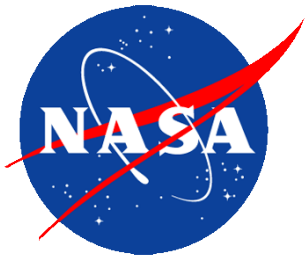
MDL – Services and Capabilities

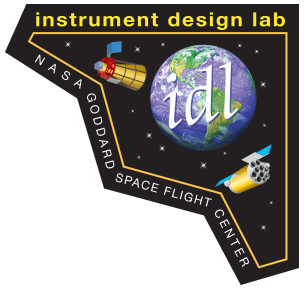
Services:

- End-to-end mission concept development
- Engineering evaluations
- Trade studies
- Technology, risk, and independent assessments
- Requirement refinement and science traceability
- Mass, power, data resource allocation
- Master Equipment Lists for cost modeling

Full Range of Capabilities:

- Standard and low thrust trajectory design to LEO, GEO, libration, lunar, and deep space locations
- Observatory design of single spacecraft, constellations, formation flying, and distributed systems
- Ground system concept development, including services and products
- Launch vehicle accommodations
- End-of-Mission considerations including controlled and uncontrolled de-orbit, reconnaissance and landing, sample return, etc.





- **Instrument Design Lab (IDL)** - offering conceptual design and analysis of instrument systems (building 23, room C340)

- **Mission Design Lab (MDL)** - offering conceptual end-to-end mission design and analysis (building 23, room C318)