CCAT Management Plan

T. Sebring & S. Radford
Project Managers
19 July 07

Basis of Management Approach & Techniques

- Formal Aerospace Corporate Methodology
- Management Seminars at Kodak
- Successful Management of Dozens of Contracts at Aerospace Companies
- Successful Implementation on HET, SOAR, and DCT Projects
- Evolving Process, Tailored to Project, Host Institution, Requirements of Partnership
- Structured to Provide Creativity, Efficiency, and Transparency

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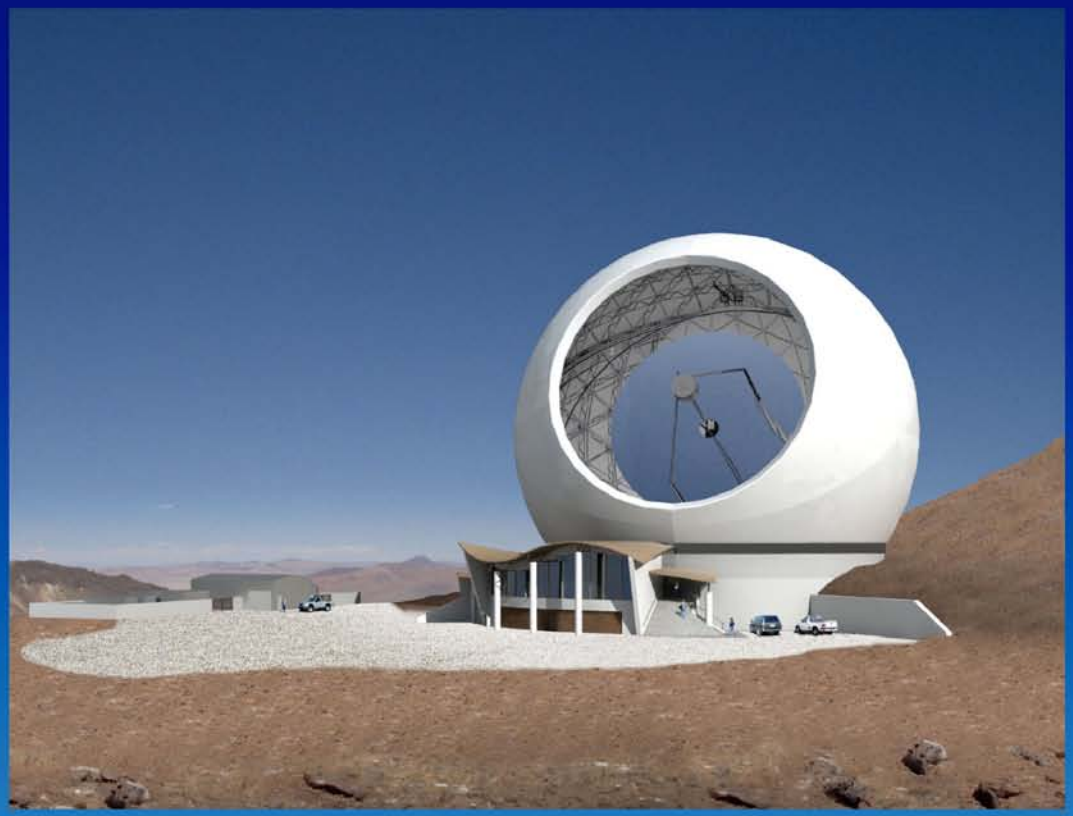
Basic Elements of Management Plan

- People
  - Organization
  - Staffing
  - Committees & Teams
  - Management Tools
  - Checks and Balances
- Money
  - Fiscal Organization
  - Contributions From Partners
  - Contracting
  - Accounting and Financial Planning
- Infrastructure
  - Project Offices & Support Services
  - Relocation & Integration Strategies
- Schedule
  - Overall Project Schedule
  - Schedule for Development of Partnership
- Critical Risk Assessment

Basic Elements of Management Plan



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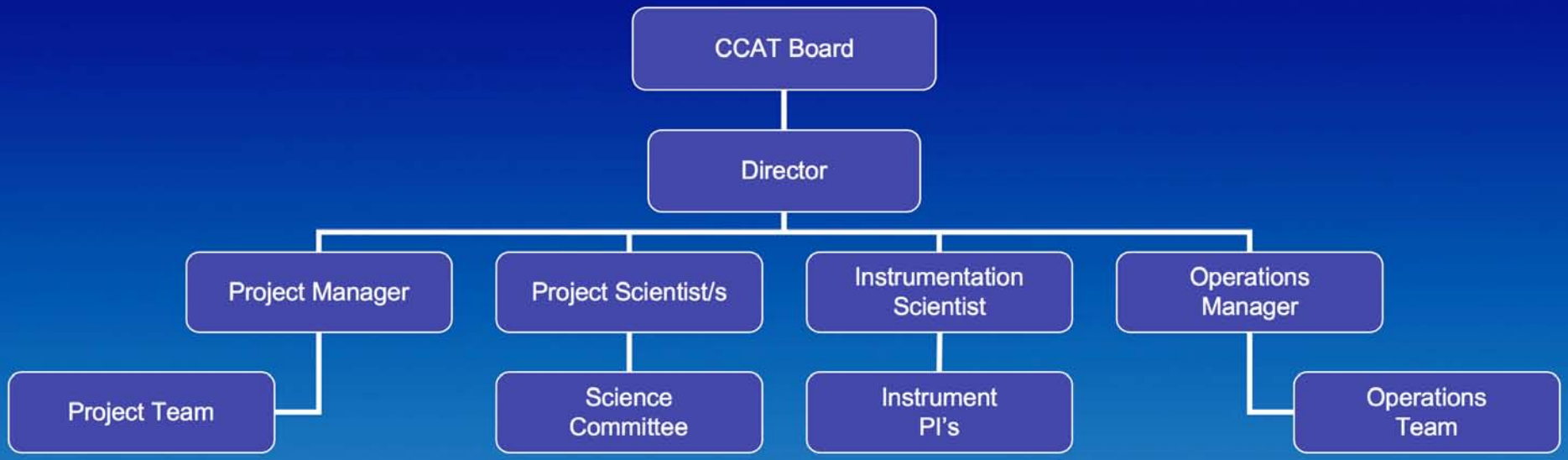
Project Organization



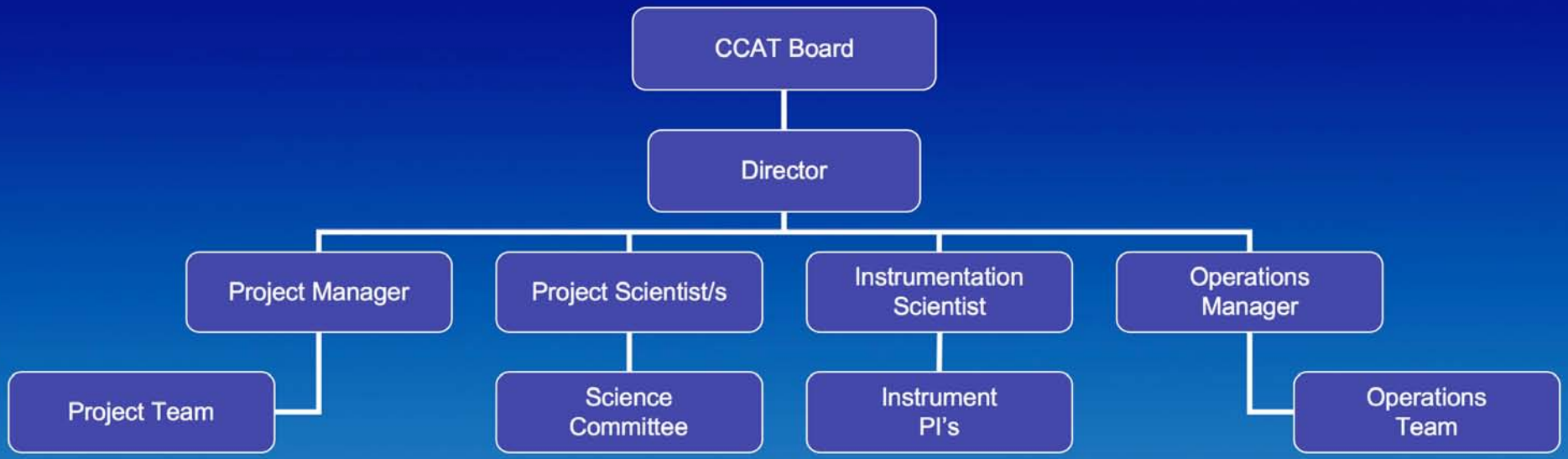
Design and Construction of Telescope Through Commissioning

Science Direction & Ensure Scientific Quality and Efficacy of Telescope

Development and Commissioning of 1st Light Instruments

Operate & Maintain Telescope and Operational Services

Project Organization



Design and Construction of Telescope Through Commissioning

Science Direction & Ensure Scientific Quality and Efficacy of Telescope

Development and Commissioning of 1st Light Instruments

Operate & Maintain Telescope and Operational Services

~20 FTE
$80M

~2 FTE
$TBD

~10 FTE
$20M

~20 FTE
$5M/yr

Project Staffing

Skill	Number	US Office	Chile
Project Manager	1	*	>
Deputy Project Manager	1	*	>
Administrative Assistant	1	*	
Project Engineer	1	*	>
Site Manager	1		*
Administrative Manager	1		*
Systems Engineer	1	*	>
Electrical Engineer	1	*	>
Mechanical Engineer	2	*	>
Control Engineer	1	*	>
Software Engineer	1	*	>
Mechanical Technician	2		*
Electronic Technician	2		*
Software Technician	1	*	>
Scheduler/Planner	1	*	
Administrative Specialist	1	*	
	19	12	13

- Initial Definition, May Evolve
- “>” Means Starts in US…Moves to Chile
- Effort Made to Hire Chileans Who Can Return and Stay
- Desirable to Hire Some Who Will Transition to Permanent Operations Team
- Lean/Mean Team Does System Engineering & Manages Contractor Efforts
- Use Contracts for Other Labor

Project Teams & Committees

- Science Committee: Chaired by Project Scientist/s
  - Develop and Maintain Vision of Scientific Objectives
  - Ensure Scientific Efficacy of Telescope via Independent Assessment
  - Participate in Engineering Development and Review of Telescope
  - Oversight of Instrumentation Development
  - Ombudsmen for Other Partner Scientists
- Instrument Scientists
  - Responsible for Design and Development of Instruments
  - Participate in Development of Telescope Instrumentation Interface Definition
  - Commissioning & Debug
- Operations Team
  - Begin Forming Early in Project Development
  - Transfer of Corporate Knowledge
  - Look for Opportunities to Populate from Project Team and Chile
  - Development and Implementation of Operations Approach

Integrated Product Teams (IPTs)

- IPT's Formed as Required to Address Major Subsystems and Tasks
  - Facility, Dome, Mount, Primary Mirror, Panels, etc.
  - Drawn Primarily from Project Team
  - Members from Science Committee, Instrument Builders, Additional Partner Resources as Required
  - Best Mix of Skills and Leadership for Each Specific Task
  - Leadership of Each Team as Indicated by Nature of Task
  - Fosters Team Spirit Through Interdependence & Provides Flexible Allocation of Resources for Changing Focus During Project
- Science Participation During Design & Development
  - Members of IPTs from Science Community as Desired
  - All Requirements Documents, Specifications, and other Controlling Documentation Requires Review and Sign Off by Project Scientist
  - Science Committee Invited to all Significant Design Reviews
  - Project Team Responsive to Science Committee Requests for Additional Information or Analysis

Design Philosophy

- Flow Down of Top Level Requirements to Subsystems via System Engineering
- Decompose Observatory Along Natural Planes of Cleavage
- Seek and Implement Efficient Design Approaches
- Formal Trades for Deciding Between Competing Concepts
  - Criteria, Weighting, Assessment, Decision
- Use Previously Proven Approaches Where Possible
  - Examine Existing and Planned Telescopes for Ideas
- Use Off the Shelf Systems and Technologies Where Appropriate
- Develop or Extend Technologies Only Where Needed
- Minimize Part Count & Machining Operations & Optimize Manufacturing Approaches: i.e Industrial Engineering

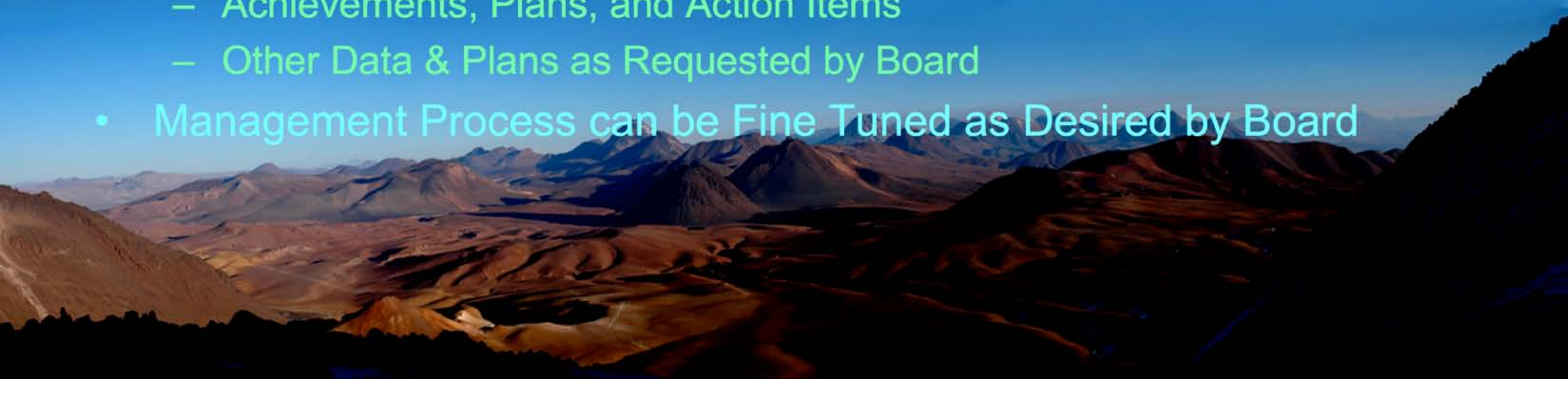
The Project is an Engineering not Science Project:
i.e Within the State of the Art Wherever Possible
for Minimum Cost and High Reliability

Management Tools

- WBS: The Basic Approach to Organization
- Cost Estimation Spreadsheet by WBS (90% Anchored Costs)
- MS Project Schedule Used for Integrated Project Schedule
- Cost Planning and Tracking System (Proven Approach)
- Integrated Product Teams
- Interface Control Documentation Developed with Contractors
- System and Subsystems Requirements Documents
- Flow Down of Requirements via Systems Engineering
- Standardized Statements of Work
- Standardized Contracts
- Configuration Control System & Library of Documentation
- Regular Status Reviews, Design Reviews, Open Door Policy
- Standard Development Process (Concept, Preliminary, Critical)
- Critical Risk Assessment and Mitigation
- Concurrent Design & Engineering
- TQM Practices & Statistical Quality Control
- Management by Walking Around (Contiguous Office Spaces)
- Early Detection, Disclosure, Remediation of Schedule, Cost, Performance Problems

Checks and Balances

- Board Approval Required for Expenditures over $25,000
- Project Manager, Project Scientist/s, Instrumentation Scientist/s, Operations Manager All Report to Director or Board Independently
- Science Committee Approval Required for All Controlling Documentation
- Science Committee Members Participate on IPT's as Desired
- Status Reports to Board 2x per Year (at In-Person Meetings)
  - Technical Status and Issues,
  - Up to Date Financial Report & Cost to Complete
  - Contractual Status
  - Achievements, Plans, and Action Items
  - Other Data & Plans as Requested by Board
- Management Process can be Fine Tuned as Desired by Board



Fiscal Organization of Project

- Anticipate and Recommend Formation of Not-For-Profit Entity
  - Provides Independent Structured Participation of All Partners
  - Can Provide Liability Protection
  - Provides Clear Structure for Tax and Non Profit Issues
  - Can be Formed Easily and at Little Expense Allowing Application for Status Under Chilean Astronomy Law and for Use of Telescope Site
- Anticipate Direct Contribution of Funds to Project by Partners
  - In-Kind Contributions Limited Largely to Scientific Instrumentation
  - Provides for Central Contracting by Project
    - Integrated Systems Engineering
    - Standardized and Comprehensive Controlling Documentation (SOWs, Reqts)
    - Close Project Monitoring of Technical Quality, Contract Compliance, Rate of Progress, and Other Contractor Issues
    - Vigorous Independent and Geographically and Politically Neutral Assessment and Remediation of Contractor Non-Compliance Issues
- Project Will Make Strong Effort to Spend Partner Funding in Country of Origin
  - ID and Approach Contractors for Appropriate Telescope Subsystems
  - Set-Asides Possible at Board Discretion

CCAT Business Entity

Board Item

- Cornell and Caltech Counsel Agree that Independent Counsel Representing All Partners Equally Should be Retained
  - Concerns Regarding Conflict of Interest if One Partner's Counsel Used
  - Specific Expertise in Types of Organizations & Tax Implications
- Cornell Recommended Bond Schoeneck & King PLLC
  - Specific Expertise in Setting up Not-for-Profits for Universities etc.
- Sebring Met with Paul W. Reichel at BS &K Syracuse, NY Office
  - Received Proposal Distributed to CCAT Partners
  - Key Elements of Proposal
    - Trade and Recommend Type of Entity
    - Legally Organize and Establish Entity
    - Obtain Tax Free Status from NYS and Federal Govt.
    - Provide Additional Post-Organization Services
  - Estimate of Costs: $45-55K
- Achieving This Would Allow us to Apply for Formal Status and Use of Site in Chile
  - A Key Element in Development of Partnership Agreement and Determining How Contracts Will be Let and Monies Handled

Seek Board Approval to Hire & Funding

Contracting Approach

- Project Team Derives Subsystem Requirements from System Engineering Effort…Flow Down from Top-Level Requirements
- Statements of Work and Requirements Documentation Developed
- Contractors Informed via Funded Studies or Unfunded Interaction or Bid Conferences
- Competitive Bid Approach Provides Cost and Performance Competition…FAR Compliant Process Likely
- Selection Criteria and Draft Contract Provided as Part of Solicitation of Bids
- Most or All Contracts Will be Firm Fixed Price to Control Growth
- Contractor's Proposal Must Include any Objections to Contract Terms
- Source Selection Committee with Science and Management Participation Will Make Recommendations to Board
- Contracts Will Have Payment Schedules Keyed to Accomplishments
- Management of Contracts Will Provide for Early Problem Detection & Resolution e.g. May Require Use of Earned Value Tracking by Contractors
- May Use Incentive and Penalty Clauses

Fiscal Control

- Cost Planning and Tracking System (CPTS)
  - Sebring Developed Spreadsheet System Tracks Finances by Month
  - Allows Initial and Revised Allocation of Funding in Near Real Time
  - Can be Resolved with Independent Accounting Quarterly to Ensure Accuracy…Annual Certified Audits and Reports Planned
  - Accounts for All Labor, Overheads, Contracts, Purchases, Travel, etc.
- Fiscal Status Presented to Board 2x per Year
  - Review of Expenditures in Last Reporting Period
  - ID of Significant Deviations from Plan
  - Detailed Cost to Complete
  - Provided for Board Review In Advance of Meeting
  - Annual Independent Audit
- Board Approval Required for Expenditures or Contracts >$25K
- Early Detection and Disclosure of Any Technical Issues and/or Potential Cost Overruns Permit Group Problem Solving

CPTS Spreadsheets Will be Provided to Board Prior to and For Discussion at Each Board Meeting When Additional Information is Available

Project Offices Infrastructure

Board Item

- Plan to Site Project at Cornell University
  - Allows Project Team to Focus on Project Issues
  - Maintains Close Contact with Astronomy Community
  - e.g. Office Space, Accounting, Legal Services, Personnel, Purchasing, Travel, Communications, Employee Insurance, Investment of Funds
- Compensate Cornell Either Directly or Indirectly (Overhead) for Services and Infrastructure
  - Provides for Reduced Cost Relative to Staffing and Contracting by Smaller Project Organization
  - Enables Fractional FTE Manpower as Opposed to Dedicated Personnel
- Potential Office Space Identified at Several Locations at Cornell
- Board Asked to Consider Concept and Request Proposal from Cornell to Enable Informed Decision
- Meeting with Charles Fay, Cornell Vice President Research Administration
  - Cornell Can Provide Necessary Services and Infrastructure
  - Will need to Investigate Costs and Charging Schemes

Remote Site Strategies

- Time Phased Activities in Chile
  - Site Development
  - Facility Construction
  - Integration of Dome and Mount
  - Installation of Control System
  - Assembly of Optics Systems
  - Integration of Instrumentation
  - Commissioning
- Ramp Up of Personnel as Required for On-Site Support
  - Likely to Hire a Chilean Site/Construction Manager
  - Hire Additional Chileans or Others Who can Transition to Ops
  - Hire Key Project Team Personnel with Understanding that Job Requires ~2 Years Residency in Chile
  - As Contracts for Subsystems are Completed, IPT Leaders Move to Chile to Direct Assembly/Integration/Debug
  - Costs for Relocation and Repatriation Must be Considered in Estimate
  - ~3-4 Personnel in San Pedro & Remainder Work Turno from TBD City

Chilean Affairs I: Institutional Status

Board Item

- Chilean Law 15.172 "The Astronomy Law"
  - Offers Privileges for International Orgs. Operating Observatories
    - Same Privileges as ESO treaty
    - Exemption from Taxes, Import Duties, etc.
    - (Limited?) Jurisdictional Immunity
  - Status Enjoyed By AURA, Carnegie, AUI, Caltech (CBI), Et Al.
  - Land Use Is A Separate Issue
- Process
  - Complete Scientific Cooperation Agreement with University of Chile
  - Application to Foreign Ministry; RoI Único Tributario (RUT) issued
  - 6–12 months to Obtain Approval
- Issues
  - Identification of Organization to represent CCAT in Chile
  - Legal Title To All Equipment In Chile Held By CCAT Representative
  - Business Model In Chile: Contracting, Personnel, Etc.

Seek Board Approval to Initiate Process

Chilean Affairs II: Land Use

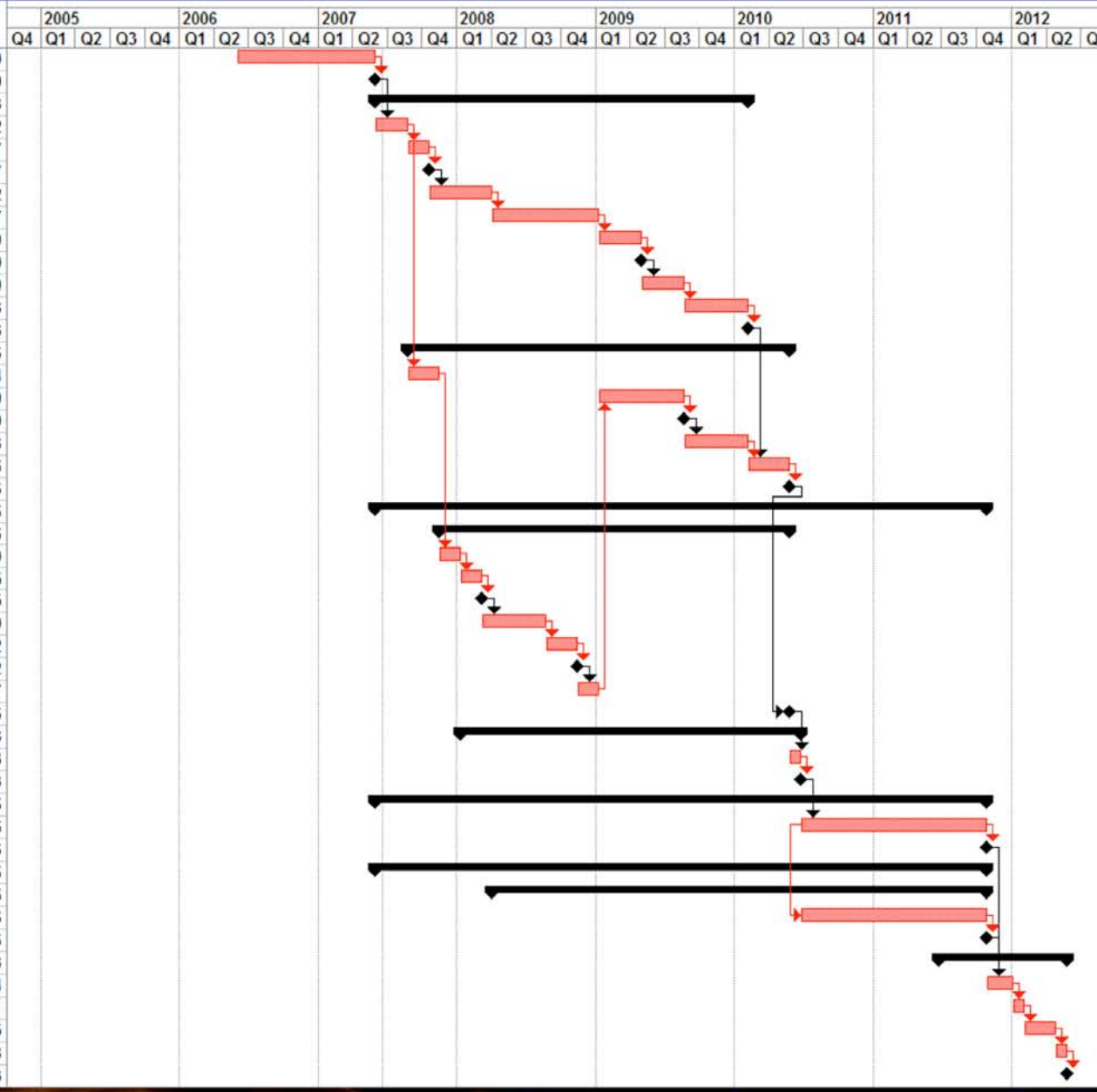
Board Item

- Cerro Chajnantor
  - Land Owned by Chilean Government (Bienes Nacionales)
  - Inside Science Preserve, but Outside ALMA Concession
  - Comisión Nacional De Investigación Científica Y Tecnológica (CONICYT) Holds 5 Yr Concession, is Preparing Application For 50 Yr Concession
- Process
  - CCAT Requests Concession to Use Site From CONICYT
  - Requires Up to 1 Year for Approval
- Issues
  - Concession Fees
  - Environmental Impact Assessment Required
  - Approval From Indigenous Affairs Agency And Local Government
  - Inter Project Agreements With ALMA (Road Use) And TAO (Neighbor)

Seek Board Statement of Intent to CONICYT

Project Schedule
Critical Path Analysis

ID	Task Name	Duration	Start	Finish
3	Engineering Concept Design	13 mons	2006-06-01	2007-05-30
4	Concept Design Review	0 mons	2007-05-30	2007-05-30
42	DOME DEVELOPMENT	35 mons	2007-05-31	2010-02-03
43	Prepare Dome Docs	3 mons	2007-05-31	2007-08-22
44	Dome Procurement	2 mons	2007-08-23	2007-10-17
45	Sign Dome Contract	0 mons	2007-10-17	2007-10-17
46	Dome Detailed Design	6 mons	2007-10-18	2008-04-02
47	Dome Fabrication	10 mons	2008-04-03	2009-01-07
48	Dome Trial Erection	4 mons	2009-01-08	2009-04-29
49	Dome Acceptance Testing	0 mons	2009-04-29	2009-04-29
50	Dome Packing & Shipping	4 mons	2009-04-30	2009-08-19
51	Dome Installation	6 mons	2009-08-20	2010-02-03
52	Dome Complete	0 mons	2010-02-03	2010-02-03
54	MOUNT DEVELOPMENT	36 mons	2007-08-23	2010-05-26
55	Prepare Mount Docs	3 mons	2007-08-23	2007-11-14
60	Mount Trial Erection	8 mons	2009-01-08	2009-08-19
61	Mount Acceptance Testing	0 mons	2009-08-19	2009-08-19
62	Mount Packing and Shipping	6 mons	2009-08-20	2010-02-03
63	Mount Installation	4 mons	2010-02-04	2010-05-26
64	Mount Complete	0 mons	2010-05-26	2010-05-26
66	PRIMARY MIRROR DEVELOPMENT	57.5 mons	2007-05-31	2011-10-26
67	Truss Development	33 mons	2007-11-15	2010-05-26
68	Prepare Truss Docs	2 mons	2007-11-15	2008-01-09
69	Truss Procurement	2 mons	2008-01-10	2008-03-05
70	Sign Truss Contract	0 mons	2008-03-05	2008-03-05
71	Truss Fabrication	6 mons	2008-03-06	2008-08-20
72	Truss Trial Erection	3 mons	2008-08-21	2008-11-12
73	Truss Acceptance Testing	0 mons	2008-11-12	2008-11-12
74	Truss Interface to Mount Contractor	2 mons	2008-11-13	2009-01-07
78	Truss Complete and Installed	0 mons	2010-05-26	2010-05-26
80	Actuator & Panel Interfaces	32 mons	2008-01-10	2010-06-23
87	Actuator Installation	1 mon	2010-05-27	2010-06-23
88	Actuators Complete	0 mons	2010-06-23	2010-06-23
90	PM Panel Development	57.5 mons	2007-05-31	2011-10-26
99	Panel Installation	17.5 mons	2010-06-24	2011-10-26
100	Panel Installation Complete	0 mons	2011-10-26	2011-10-26
113	SENSOR SYSTEM DEVELOPMENT	57.5 mons	2007-05-31	2011-10-26
114	Edge Sensor System	46.6 mons	2008-04-01	2011-10-26
122	Edge Sensor Installation	17.5 mons	2010-06-24	2011-10-26
123	Edge Sensors Complete	0 mons	2011-10-26	2011-10-26
169	COMMISSIONING	12 mons	2011-06-23	2012-05-23
171	Image Quality Optimization	2.5 mons	2011-10-27	2012-01-04
172	Install First Science Instrument	1 mon	2012-01-05	2012-02-01
173	Dual Science/Engineering Ops	3 mons	2012-02-02	2012-04-25
174	Final Testing	1 mon	2012-04-26	2012-05-23
175	Commissioning Complete	0 mons	2012-05-23	2012-05-23



Schedule Issues

- Delays in Starting "Real" Development Probably Day-for-Day Slip in 1st Light and Full Science Ops Dates
  - ~1 Year Lost Since This Schedule Was Established
- Schedule Assumes that General Construction at Telescope Can be Accomplished in 20 Months…Weather Delays Could Easily Put Facility in Critical Path
  - Need to Establish Capability for Road Clearing and Maintenance Early
- Likely That Telescope Can Begin Operations with Partially Filled Aperture
  - Manufacture of Remaining Panels and Installation Can be Ongoing
- Schedule Can be Reworked as More Recent Contractor Inputs Received
  - Have Intentionally Not Produced a Series of Ever Changing Schedules

Schedule Will be a Living Document, Highly Detailed and Revised for Best Completion as Project Develops and Additional Information is Available

Provided for Review at Each Board Meeting

Suggested Schedule/Approach for Partnership Development

Board Item

- Target Completion/Signing for July 2008 … 1 Year from Now
- Select Consortium Agreement Development Committee & Chair
  - This Board Meeting?
- Development of Term Sheet 3 Months
  - Presentation to Board and Telecon Discussion in October 2007
  - Defines Key Terms for Agreement in Simple Language
  - Revise Based on Board Suggestions
- Development of Draft Agreement 3 Months
  - Presentation to Board and Discussion in January 2008
  - Revise According to Board Input
  - Board Members Present to Respective Administrations for Comments
  - Revise According to Institutions Inputs
- Development of Revised Agreement 3 Months
  - Presentation to Board and Telecon Discussion in April 2008
  - Revisions as Required
- Signing of Agreements 3 Months
  - **Complete in July 2008**

Project Office Can Assist in Drafting Docs, Communications, Legal Support

Suggested Schedule/Approach for Funding Development

Board Item

- Select Ways and Means Committee & Chair…This Meeting
  - Responsible for Integrating Plans and Capabilities of Partners
  - Determining Common Denominator Schedule for Development
  - Leading Activities at Their Respective Institutions
  - Providing Progress Updates to Board
- Determine Status and Develop Plans at Institutions 3 Months
  - Identify Gating Requirements for Approval at Institutions & Schedule
  - Presentation to Board and Telecon Discussion in October 2007
- Summit Meeting of Senior Partner's Administration
  - At Jan 07 Board Meeting??? In Chile???
  - Opportunity for VP's, Provosts, Presidents, to Meet Face-to-Face
- Continue Development
  - Presentation to Board and Telecon Discussion in April 2008
- Commitment of Institutions Integral with Approval of Agreement
  - **First Substantial Contributions in August of 2008**

Project Office Can Provide Support to Fund Raising via Briefings, Materials, etc.

Fiscal Status: Cost Estimate from FCD Study

- Fairly Detailed
- Have Reduced Cost in Some Areas
- CPI ~4.5% Since Study~$4.5 M
- Budget is Still $100 M
- Current Expenditures Do Not Equate 1:1 With Items in Estimate

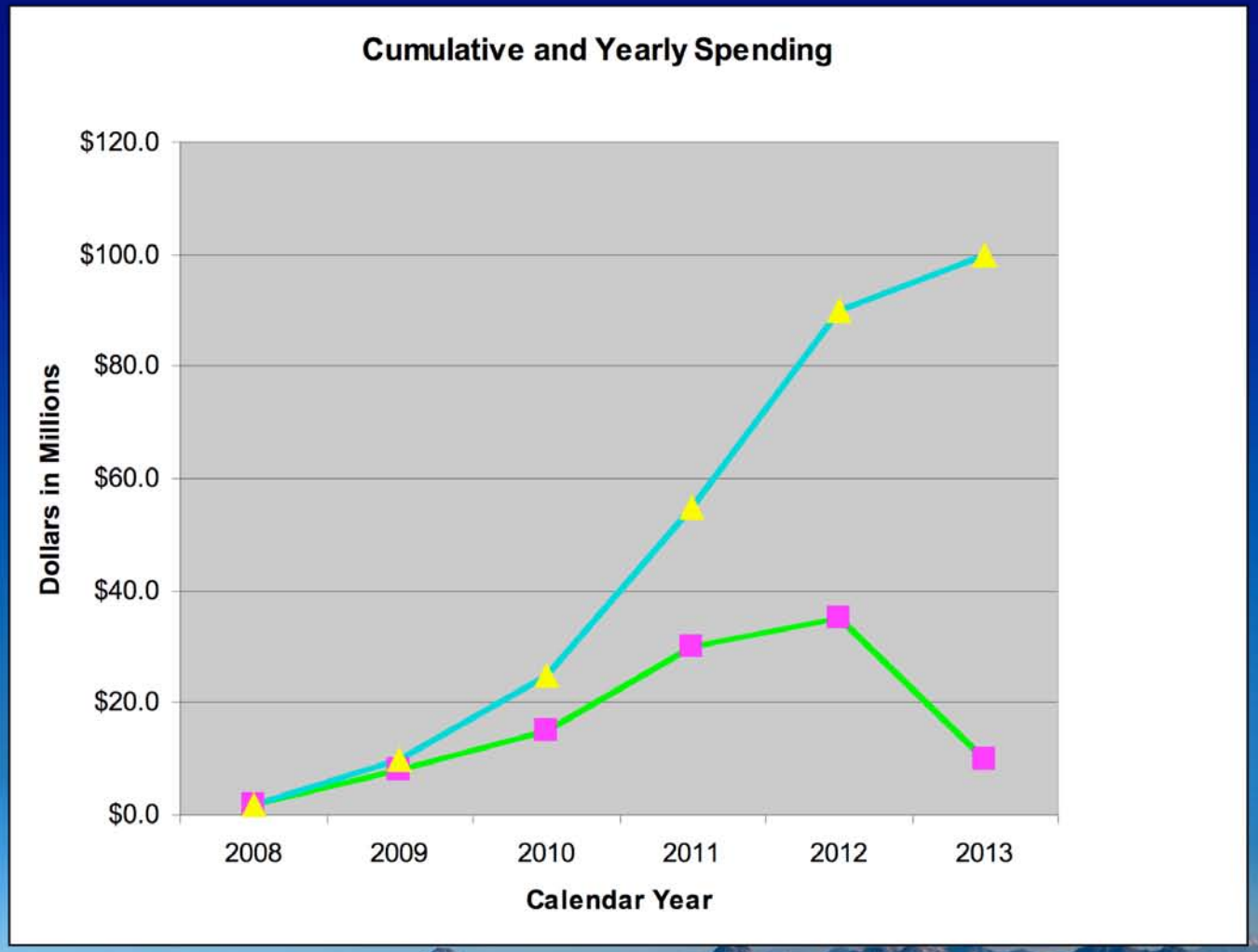
CCAT Cost Estimate	Current Estimate Area Total:	Next Phase Target
Facility and Site	$11,500,186	$9,500,000
Enclosure Dome	$13,507,642	0
Primary Mirror System	$15,356,000	0
Secondary and Tertiary Mirror Systems	$1,883,481	$2,500,000
Telescope Mount	$16,595,355	0
Telescope Alignment	$2,750,000	$2,000,000
Electronics	$250,175	$500,000
Computers and Software	$444,080	$750,000
System Engineering	$5,150,000	$4,150,000
Integration & Assembly	$1,016,100	$2,000,000
Science Instrumentation	$19,999,938	0
Management & Reporting	$277,500	$500,000
Total w/o Labor	$88,730,457	0

CCAT Labor	$7,596,500	$8,000,000
Fringe Benefits @ 32% of Raw Labor	$2,430,880	$2,560,000
Overhead on Labor @10%	$1,002,738	$1,056,000
Travel @15% of Raw Labor	$1,139,475	$1,200,000
Total Labor & Travel	$12,169,593	$12,816,000

Fiscal Status: Plans

- Updated Cost Estimate Required
- Requires More Detailed Concept Designs
- Contractor Funding and Additional CCAT Personnel Required
- Budget of $100 M Still a Reasonable Target but Tougher
- Accurate Cost Estimation Requires Expenditures and Effort Beyond the Capabilities of Current Funding and Personnel
- Concept Development is the Only Real Way to Reduce Costs
  - Identifying Lower Cost Approaches to Subsystem Development
  - Contractor Have Supported Our Work Well, but Now Need Funding to do More Concrete Work
- CCAT Will Cost More the Longer We Take to Build It

Draft Funding Schedule



- Standard Construction Project "S" Curve
- Sufficient Bow Wave of Funding to Guarantee Contracts
- Interest on Deposited Funds Helps Offset Inflation

Draft Contribution Schedules

Phase	Year	Required	% of Total	Cumulative $	5% Share	10% Share	15% Share	20% Share	25% Share	30% Share
Concept Design	8	$2.0	2.0%	$2.0	$0.1	$0.2	$0.3	$0.4	$0.5	$0.6
Preliminary Design	9	$8.0	8.0%	$10.0	$0.4	$0.8	$1.2	$1.6	$2.0	$2.4
Detailed Design & Mfg	0	$15.0	15.0%	$25.0	$0.8	$1.5	$2.3	$3.0	$3.8	$4.5
Detailed Design & Mfg	1	$30.0	30.0%	$55.0	$1.5	$3.0	$4.5	$6.0	$7.5	$9.0
Integration	2	$35.0	35.0%	$90.0	$1.8	$3.5	$5.3	$7.0	$8.8	$10.5
Commissioning	3	$10.0	10.0%	$100.0	$0.5	$1.0	$1.5	$2.0	$2.5	$3.0
Total		$100.0			$5.0	$10.0	$15.0	$20.0	$25.0	$30.0

US Dollars in Millions

- Soft Start While Project is Staffed and Concept Designs Developed
- Sufficient Funding at End to Ensure Performance Objectives are Met
- Project Could Be Tailored to Meet This Exact Schedule or Project Modified to Suit Abilities of Partners
- Need Not be Pro Rata for All Partners at Each Contribution Date
- Partnership Agreement Likely to Contain Contribution Schedule

Proposed Dates & Venues for Next Board Meetings

Board Item

- Interim Agreement Provides for 2 In-Person Board Meetings and 2 Telecons per Year
  - Implies Telecons in October 2007 and April 2008
  - In Person Meetings in January and July 2008
- General Strategy
  - In Person Location Rotates Between All Partners With an In Person Meeting at the Project Offices Every Other Meeting
    - This Allows the Project Team Task Leaders to Brief the Board on Their Project Areas Once per Year for a More In Depth Review
    - Allows All Partners to Host Board Meeting Periodically
    - Meeting with Project Team Can be in Chile or Ithaca
- Suggestions:
  - San Pedro de Atacama in January 2008
    - Important for Board to Get 1st Hand Knowledge of Conditions on the Ground
    - Chilean Relations Could be Enhanced by Interface
  - Royal Observatory of Edinburgh Astronomy Technology Centre July 2008
    - Enables Rotation to Another Partner
    - Acceptable Weather Possible at This Time of Year!

Good if Board Can Decide Dates & Times for Next Meetings/Telecons

Critical Risk Items

- Delay of Project
  - Continued Inflation of General Costs, Higher Fuel Costs, Higher Steel and Construction Costs
  - Reduction of Synergy with ALMA, Their Operational Modes Established Before We Begin Ops
  - Potential for Project to Become “Stale” or OBE
- Cost Limit for Project
  - Depends to Some Extent on Scope Determined by Partners
  - Original Target of $100 M is Still Feasible
  - Additional Design Work and Project Team Members Required to Improve Accuracy of Estimate
- Technology
  - Performance of Telescope Not a Disproportionate Risk
  - Some Subsystems Higher Risk than Others
    - Mirror Panels, Mirror Alignment and Sensing, Dome Mechanics
    - Conceptual Development of Subsystems Basis for Cost Reduction

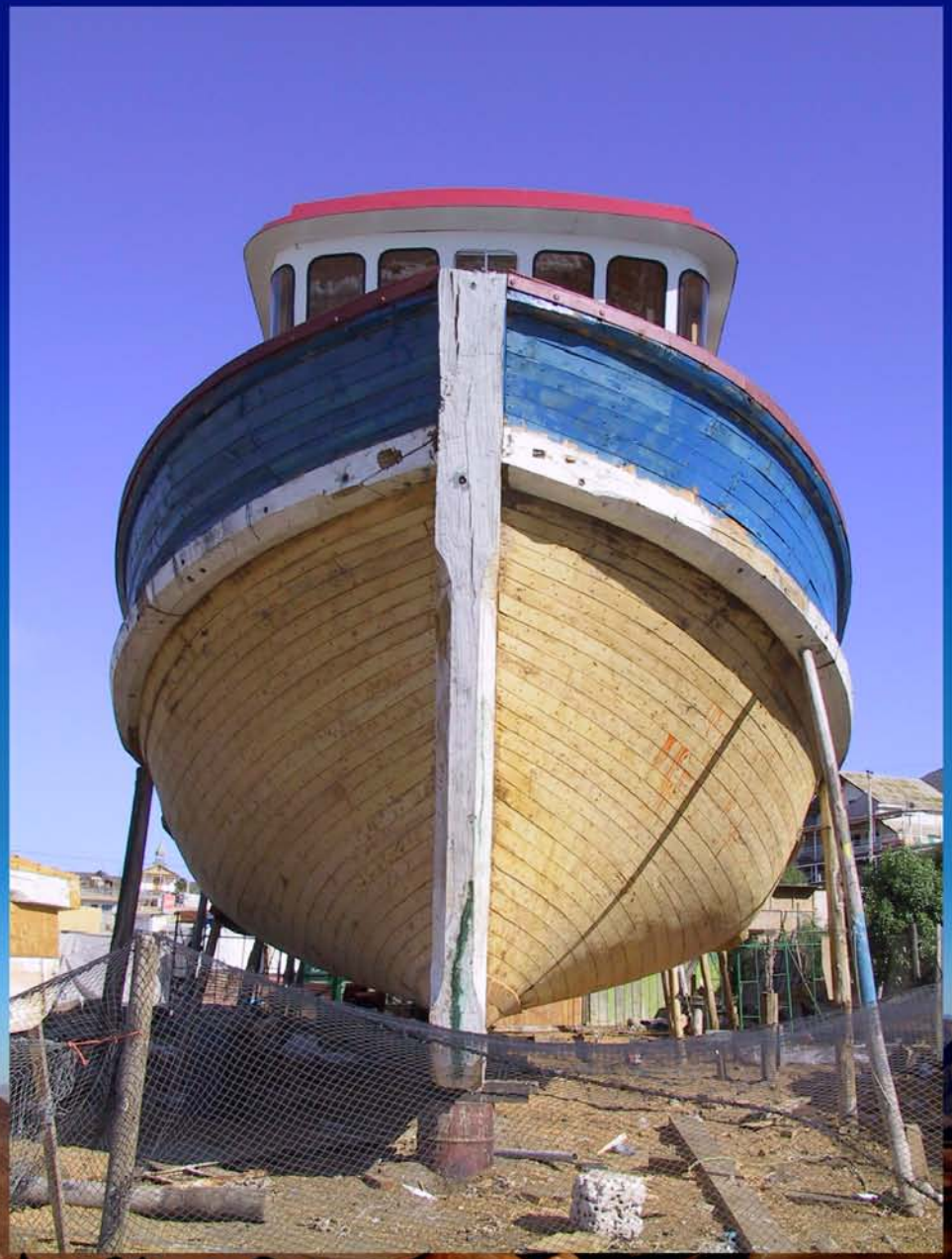
Poised to Move Forward Smartly When Funds Available

The Next Year: Toward Construction

- Hire Project Engineer: Additional Support to System Engineering and Development of Subsystems
- Conduct Site Surveys: Geotechnical and Topographic
- Establish Increased Presence on Site: Container, Interferometer etc.
- Fund Industrial and Analytical Studies
  - Panel Tip/Tilt Alignment Metrology System Design Study
  - Design & Manufacturing Studies for Composite Panels
  - Site Development Bid Plans & Revisit Facility Architectural Design
  - Study Dome Mechanical Drive and Bearing Systems
  - Additional Study/Simulation of PM Panel Control System
  - Provide Funding for 1st Light Instrument Concept Design
- Additional Design Review Meetings
- Required Funding: ~$1-2 M…Scope of Activities Can be Tailored to Fit Amount Board Sees as Possible

If the CCAT Consortium is Serious About Building This Telescope We Should Not Spend the Next Year Below Critical Mass in Development Activities

Summary



- Plans Implementing Proven Management Approach Established
- Board Inputs to Improve Approach Welcomed
- Technical Risk Reduction Progressing Acceptably
- Need “Real” Funding to Begin Project Soon
- Cost and Completion Dates Affected by Any Delay in Funding